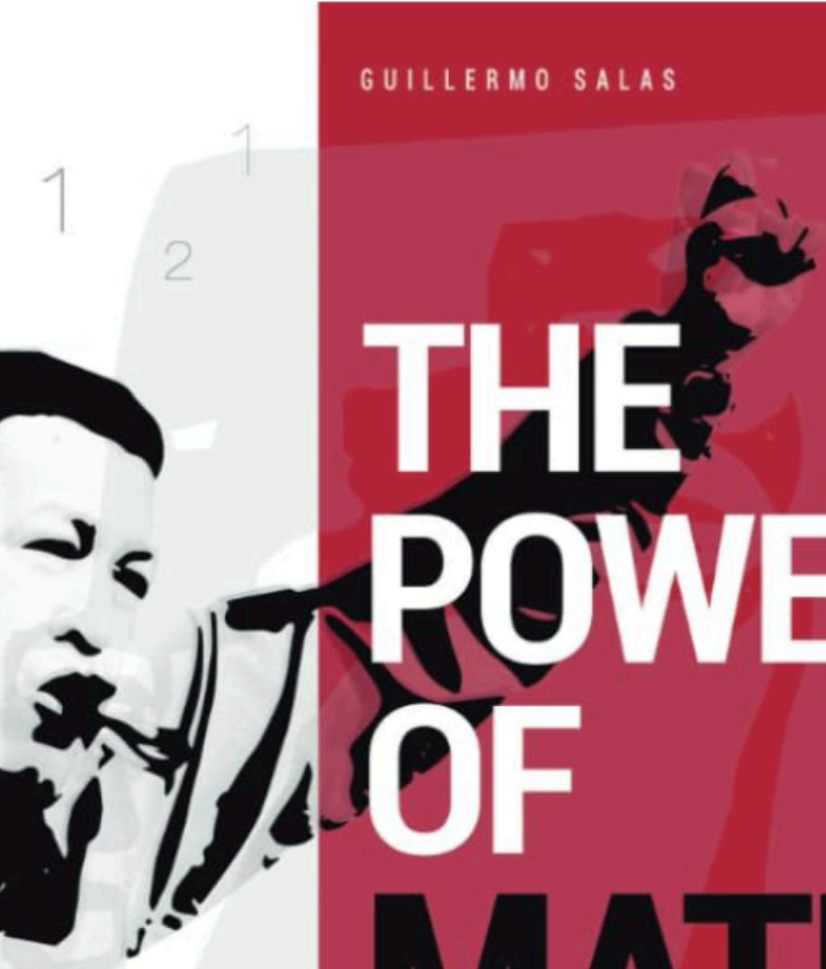
GUILLERMO SALAS

THE POWER OF MATH

THE VENEZUELAN ELECTRONIC VOTING SYSTEM THAT SPREAD THROUGHOUT THE WORLD





Have the mathematics the power to decipher how the electronic voting system imposed by Chavismo in Venezuela works?

In 2004, a referendum was held in Venezuela on which the permanence of Hugo Chávez in the presidency of the Republic depended. The official result gave him the victory and thanks to that he was able to remain in power. This was the debut of the voting machines of Smartmatic.

The lack of transparency that marked that event left many Venezuelans with the feeling of fraud. Several groups of academics produced writings that show evidence, based on statistical mathematics against the veracity of the results that the machines had given. Some of them were published by important scientific journals such as *International Statistical Review* and *Statistical Science*.

Smartmatic began a vertiginous expansion that led it to become a world leader in voting automation. This started only seven months after that referendum with the purchase of Sequoia Voting System, a company that years later would become the property of Dominion Voting System. For all this, deciphering how the voting machines that debuted in the Venezuela governed by Chávez work is a relevant and global issue.

Throughout this book, its author Guillermo Salas physicist and co-author of the article *Analysis of the 2004 Venezuela Referendum: The Official Results Versus the Petition Signatures* published by *Statistical Science*, shows a series of facts that allow the reader to answer by themselves if the mathematics have the power to decipher how this voting system works or not. It does it using simple, intuitive and enjoyable language, which does not require specialized knowledge from the reader.



The Power of Math

Guillermo Salas D.

LA ESQUINA
DEL ÁLVEO

LA ESQUINA DEL ÁLVEO

Editorial: https://laesquinadelalveo.es
Mail: info@laesquinadelalveo.es
Tel: +34 650 637 780

Autor: Guillermo Salas D.
Título: El poder de la matemática

Primera edición: Marzo de 2024

ISBN: 978-84-126777-5-1

Maquetación: https://maquetadordelibros.es

No está permitida la reproducción total o parcial de este libro, ni su tratamiento informático, ni la transmisión de ninguna forma o por cualquier medio. ya sea electrónico, mecánico, por fotocopia, por registro u otros métodos, sin el permiso previo y por escrito del autor.
Todos los derechos reservados

The Power of Math

The Venezuelan electronic voting system that spread throughout the world.

Guillermo Salas D.

This mathematical essay is based on information that has been made public in scientific journals, in statistical papers, in official reports and communiqués, in press articles and in testimonies that have been made known through various media. The opinions and judgments expressed herein are the personal opinions of the author.

Has no intention of get involved in the various political diatribes that have been taking place in recent years in various countries around the world in which, due to an abusive simplism, they have ended presenting itself as a fight between two ideologies, "the left" and "the right", or as the confrontation between factions and characters who aspire to govern their respective countries.

It aspires to go much further, to show how the power of mathematics can help us understand and defend what is undoubtedly one of the most important achievements of the humanity: the right to choose our rulers through genuine elections.

Índice

Seven short stories about votes and elections

- "The government should know who owns our voting machines". .....
- Spain, *pucherazos* and votes by mail.....
- Bush vs. Gore: an electoral system extremely susceptible to butterfly votes. .....
- Philippines: two presidential elections, two unforeseen situations.....
- A meme with a lot of past. .....
- Voting machines and connectivity.....
- Testimonials so disruptive that many prefer to ignore them .....

Section 1: How science works: the counterposition of arguments

1.1. Galileo and the opposition of antagonistic models. .....
1.2. "Plausible explanation": a relative concept, but to some extent.....
1.3. Why and how to apply the method of contrasting arguments in the present case of study...

Section 2: Evidence of electoral fraud based on connections and degrees of separation

2.1. Crimes, connections and degrees of separation.....
2.2. Backgrounds to the establishment of the electronic voting in Venezuela.....
2.3. The development of the electronic voting system of the SBC Consortium and its relationship with the Chavez government. .....
2.4. Counterposition of arguments about the reason for the investment of the Venezuelan State in Bizta.....

Section 3: The debut of the voting system of the SBC Consortium

3.1. Audit of software and hardware, voting and scrutiny of the votes.....
3.2. The planned audit of the results from the voting machines.....
3.3. On the effectiveness of the audit used to certify the results of the voting machines .....

Section 4: Statistical mathematics and electoral fraud detection

4.1. Driven to statistical mathematics by a state of necessity.....
4.2. Allegations of electoral fraud based on statistical mathematics. .....

Sección 5: Counting the second digits

5.1. Benford's Law and fraud detections .....
5.2. Benford's Law and the official results of the 2004 referendum in Venezuela .....
5.3. Pearson's Chi-square Test .....
5.4. The second digits of the numbers of No votes vs. the uniform distribution .....
5.5. The numbers of votes reported by the voting machines vs. number of votes created on a computer .....
5.6. In summary .....
5.7. A fact to take into accoun .....

Section 6: The mathematical fallacy that describes the behavior of the numbers of Yes vote

6.1. The hypothesis on the origin of the Yes votes numbers .....
6.2. The consequences of the behavior of the numbers of Yes votes on the result of the referendum .....
6.3. How and why the audit that was planned to be done to the results of the voting machines was curtail .....
6.4. A very revealing detail .....
6.5. The bias .....

Section 7: The biometric identification or fingerprint capture system

7.1. "That is where they can be caught on to make a fraud" .....
7.2. The modernization of the fingerprint capture system .....
7.3. The unforeseen audit of the fingerprint capture system .....

Section 8: How evidence of fraud based on numerical facts was neutralized

8.1. Academic cancellation: a long-standing custom .....
8 2. The arguments of authority that were used to neutralize the evidence of fraud present in the numbers of No votes reported by the voting machines .....
8.3. The *Statistical Science* affaire .....

Section 9: Conclusions

9.1. How to conclude about the cause of a past event .....
9.2. Concluding in favor of the voting system of the Consortium SBC .....
9.3. Concluding against the voting system of the Consortium SBC .....
9.4. The contribution of mathematics and the scientific method .....

Appendix A:
Recreating the day of August 15th, 2004 from the perspective
of the hypothesis proposed by Delfino and Salas.....

Appendix B:
A look at the article Forensic Analysis of the Venezuelan
Recall Referendum by R. Jiménez .....

References .....

SEVEN SHORT STORIES ABOUT VOTES AND ELECTIONS

“The government should know who owns our voting machines”

The voting machines of the company Smartmatic made their debut on August 15th, 2004 in a referendum in which the Venezuelans with their vote should have decided whether or not Lieutenant Colonel Hugo Chavez should continue holding the position of President of the Bolivarian Republic of Venezuela. A few months later, this company acquired Sequoia Voting Systems, which at that time was one of the largest companies in the world in terms of voting automation. When this news was known, there was a certain reaction within the political sphere. On May 4th, 2006, US Congresswoman Carolyn Maloney sent a letter to Secretary of the Treasury Department, John W. Snow, requesting an investigation to be launched [Ref. 1]. In it she says:

> I am writing regarding possible investments by the Venezuelan government in Smartmatic, a voting machine company with business in the United States and its acquisition of Sequoia, a U.S. -based voting machine company.
>
> (...)
>
> As you can imagine, having a foreign government investing in or owning a company that supplies voting machines for the U.S. Elections could raise concerns over the integrity of elections conducted with these machines. Furthermore, I would have concerns if this transaction was done outside the CFIUS process, a process that was put in place to appropriately examine these types of foreign investment.
> (...)
>
> Attached please find a series of articles regarding these countries and concerns raised about the involvement of the Venezuelan government with them including an article from the *Miami Herald* entitled “Venezuela Owns Stake in Ballots”.

Some US media such as *CNN* alerted about this purchase. On October 29th, 2006, *The New York Times* published the article by Tim Golden, *U.S. Investigates Voting Machines’ Venezuela Ties* [Ref. 2]. In it it says:

> Smartmatic was a little-known firm with no experience in voting technology before it was chosen by the Venezuelan authorities to replace the country’s elections machinery ahead of a contentious referendum that confirmed Mr. Chávez as president in August 2004.
> (...)
>
> Since its takeover by Smartmatic in March 2005, Sequoia has worked aggressively to market its voting machines in Latin America and other developing countries. “The goal is to create the world’s leader in electronic voting solutions,” said Mitch Stoller, a company spokesman.
> (...)
>
> “The government should know who owns our voting machines; that is a national security concern,” said Representative Carolyn B. Maloney, Democrat of New York, who asked the Bush administration in May to review the Sequoia takeover.

“There seems to have been an obvious effort to obscure the ownership of the company,” Ms. Maloney said of Smartmatic in a telephone interview yesterday. “The Cfius process, if it is moving forward, can determine that.
(...)

More recent corporate documents show that before and after Smartmatic’s purchase of Sequoia from a British-owned firm, the company was reorganized into an array of holding companies based in Delaware (Smartmatic International), the Netherlands (Smartmatic International Holding, B.V.), and Curaçao (Smartmatic International Group, N.V.). The firm’s ownership was further shielded in two Curaçao trust.

By the time of the 2020 US Presidential Elections, Sequoia had become the property of Dominion Voting Systems, a fact that after these elections aroused much suspicion and even some accusations.

Spain, *pucherazos* and votes by mail

Pucherazos and other fraud mechanisms

The *pucherazo*[1] was a mechanism of electoral fraud that during the Spain of the Bourbon Restoration (1874-1931) became a kind of tolerated custom. It consisted of introducing ballot papers in pots into voting stations, especially those located in rural areas, then removing them and introducing them into the ballot boxes to thus adulterate the results of the elections. Many Spaniards, even today, refer to the General Elections of 1936, which began the series of events that ended up unleashing the Spanish civil war, as "el pucherazo del 36" (the *pucherazo* of 36).

In 2017, two Spanish historians Manuel Álvarez Tardío and Roberto Villa García published the book *1936. Fraude y violencia en las elecciones del Frente Popular* (1936: fraud and violence in the Popular Front elections) [Ref. 3]. In it, the result of several years of research, its authors, based on documents from the time, reconstruct those elections and conclude that what happened in 1936 was not yet another *pucherazo*, but that it was a very well planned post-electoral falsification, in which those who made it, by changing a relatively small number of votes in certain very specific localities, guaranteed themselves the necessary seats to dominate the *Cortes*, the collegiate body that would be in charge of choosing the new government. They maintain that as a result of a group of irregularities (tears and amendments in the minutes, counting without witnesses, inclusion of votes at the last minute, inexplicable flipping of the results, interruptions and falsifications in the vote count, etc.) small local differences were created that changed the results of approximately 50 seats, which gave the victory to the Popular Front.

Real Madrid C.F. and the votes by mail

In 2006, Real Madrid C.F., one of the most important clubs in the history of soccer and with close to one hundred thousand members, organized an election where its president would be chosen. There were two ways to vote, in person at the Santiago Bernabéu Stadium or by mail. The votes collected at the Santiago Bernabéu gave Ramón Calderón as the winner. Those that arrived by post had a very different result. It was an inconsistency that there was no way to justify.

The case went to the judicial instance and Judge Milagros Aparicio was in charge of resolving it. Those who had organized the election admitted [Ref. 4]:

> ...no control was made of the authenticity of the signature of the voter and that their review or control of the envelopes sent was done by approximation or visual comparison between the autograph signature allegedly stamped by the member-voter and the one that appeared in the simple photocopy of the DNI [National Identification Document] accompanied.

On the other hand, it was found that the proper chain of custody had not existed for these votes. This is how it was established in the ruling of the judge [Ref. 4]:

> ...[the votes by mail] were kept in one or several cabinets, without continuous personal

1. The term *pucherazo* came from the word *puchero*, clay pots, often with lids, in which stews are usually prepared and stored.

> surveillance except for the sporadic recording of video cameras or similar support, the duration and effective existence of which has not even been accredited.

For these reasons Judge Aparicio declared the nullity of the votes by mail. She also argued that [Ref. 5]:

> The weakness of the guarantees of the vote cast by mail is evident when compared with the system regulated in the Organic Law of the General Electoral Regime, which expressly prohibits the admission of a photocopy of the DNI for these purposes and requires, among other requirements, verification by the postal worker not only the identification of the voter through the exhibition of the DNI but the coincidence of signatures...

A Real Madrid C.F. member was sentenced to one year, three months and one day in prison for mail-in ballot fraud. He accepted the sentence and pleaded guilty. He had been accused of "making multiple votes, providing photocopies of the documents necessary for the postal vote and the ballot of the same candidacy, and filling in and imitating the signature of the members on the paper that they were to manifest their intention to vote by mail, without their authorization or consent".

This case, thanks to the fact that two groups of votes that should have the same behavior presented unjustifiably different results (see Figure H.1), which serves to show that both the identification of the voter and the existence of a chain of custody that offers real guarantees on the electoral material, are fundamental parts of electoral integrity.

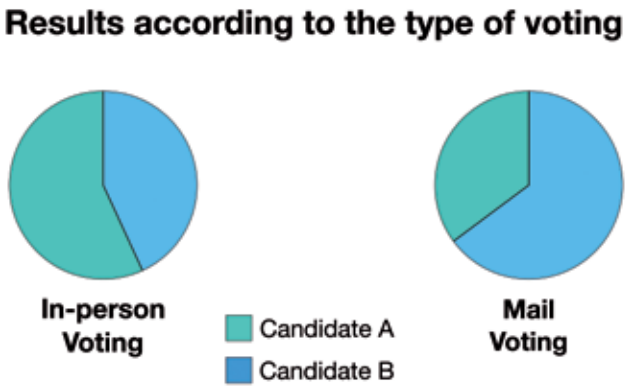


Figure H.1. Example of an in-person and mail voting with inconsistent results.

Bush vs. Gore: an electoral system extremely susceptible to butterfly votes

The American voting system is an inherently chaotic system; in a country with more than three hundred million inhabitants, small groups of votes, butterfly votes[2], in some of the fifty states that conform this union, can overturn the result of a presidential election. The origin of this is the "winner takes it all" form, which is used in most states to, based on the number of votes, calculates the number of delegates each party sends to the Electoral College. For example, in the state of Florida, which has more than twenty million inhabitants, the party that wins by a single vote takes the 30 delegates provided by this state.

In 2002 *Statistical Science* dedicated one of the four editions it publishes each year to studies of what had happened in the 2000 Presidential Elections in the USA. In these elections in which the candidate of the Republican Party George Bush (Jr) and the candidate of the Democratic Party Al Gore fought, they ended up being the perfect example of what can happen in an electoral system especially susceptible to butterfly votes.

Richard L. Smith, in his article *A statistical assessment of Buchanan's vote in Palm Beach County* [Ref. 6], when observing the behavior of the numbers of votes obtained in the different counties of the State of Florida, says:

> The present analysis establishes conclusively that Buchanan's Palm Beach vote cannot be explained away as normal statistical variation and the likely distortion of the Florida vote was at least 2,500 votes.

Pat Buchanans was another candidate and many explained the appearance of this unexpectedly high number of votes in his favor as a direct consequence of the particularly confusing way in which the voting machine screens in this county had been laid out. This could cause those who tried to vote for Gore to end up having their votes added to those of the Buchanans.

If this had been the case, an unclear design of these screens induced confusion among voters that subtracted nearly 2,500 votes from Al Gore. Because of this, in a state where close to six million voters voted, candidate George Bush defeated Al Gore by only 537 votes. Having collected in this presidential election more than one hundred million votes, these 537 votes gave the Republican Party the Florida delegates the Republican Party and a majority in the Electoral College and Bush the Presidency of the United States.

2. The term "butterfly vote" has its origin in the famous "butterfly effect". This refers to very small events, such as the fluttering of a butterfly or a small group of votes, which in the end end up generating great changes.

Philippines: two presidential elections, two unforeseen situations

2010 Presidential Election

In the Philippines, a few days after the 2010 Presidential Election, a committee of the Philippine Congress tried to clarify what had happened to the Smartmatic system that had been used. Apparently at the last minute there was an unforeseen in the synchronization between the internal clocks of this system, which reduced its ability to digitally record any electronic tampering with the results.

The following is part of a questioning chaired by Congressman Teodoro Locsin Jr. (T.L.) in which Congressman Roilo Golez (R.G.) and Venezuelan engineer Heider Garcia (H.G), the representative of Smartmatic, also participated [Ref. 7]:

— (R.G.) ...if the time and date would not coincide then these messages will be rejected as a precaution. So, I was wondering why in the case of Smartmatic you didn't have this kind of precaution, to make sure that the times are synchronized with each other. Because it is anomalous, very obvious Mr. Chairman, that when there are two entities communicating, where there is a human being or machines, they should communicate in the same time a date.
(...)

— (T.L.) Let me interrupt. As Congressman Golez said... if the sequence can be belated at 10 in the evening what the heck... My God!

— (H.G.) Sir...

— (T.L.) Your assurance was that anything that happens between 7 a.m. and 7 p.m. will be reflected as 7 a.m. to 7 p.m. I did not know that 7 a.m. to 7 p.m. could be moved to 10 in the evening. You realize what a fool you have made?

— (H.G.) Sir...

— (T.L.) Of the legislation to surpass the law?

— (H.G.) Understand Sir, but with the respect, in second thing is an unforeseen situation.

— (T.L.) Unforeseen?

— (H.G.) Yes Sir.

— (T.L.) That was the principal guarantee that this would be an honest election. That we would know digitally what would happen during election day and during election hours.

— (H.G.) And you do Sir. If I may...

— (T.L.) No no, forget that... ...

You had us, standing here, guarantee to the public and the world that even if a fraud is committed, we would be able to trace it. We never said that fraud could not be committed, but you said we could trace it. Now you tell me that at 10 in the evening you could do it and we would never know.

— (H.G.) No sir. I stand at our product.

— (T.L.) Sons of bitches!

2016 Presidential Election

For the following presidential elections, the presence of Smartmatic was highly questioned. The director of this company at the time, Lord Ma-

lloch-Brown, assured that the new contract for this company had been granted fairly and without any kind of privileges. For some Filipinos, this Malloch-Brown intervention, far from reassuring them, increased their concerns: he was perceived by many as the right hand of George Soros[3]. Despite this, in the 2016 Presidential Elections they were once again made using Smartmatic systems.

After the voting, according to information published by several Philippine newspapers, it was discovered that the system that totaled the results had some non official servers. The electoral results passed through them before reaching the official servers, where they were totaled. This is how the article *Smartmatic admits using unofficial servers* published by *The Manila Times* [Ref. 8] describes it:

> The camp of former senator Ferdinand "Bongbong" Marcos Jr. was surprised to learn directly from Smartmatic that it used several servers apart from those sanctioned by the Commission on Elections during the May 2016 elections.
>
> He cited the admission of Marlon Garcia, head of the Technical Support Team of Venezuela's Smartmatic, that aside from the three servers sanctioned by the Comelec [the Philippine electoral body] in the transmission of votes under the Automated Election System (AES), there also existed a "meet me room"[4] where several servers were housed.
>
> "This is a good day for Senator Marcos' quest for truth because they (Smartmatic) finally admitted the existence of several other servers aside from the three legally authorized servers," Rodriguez told reporters after a hearing on Thursday at the Manila Prosecutor's Office.
> (...)
>
> Marcos' camp earlier revealed the existence of a "Fourth Server" or the "Queue Servers"[5] that had been kept secret from the public by both the Comelec and Smartmatic.
>
> Rodriguez pointed out that instead of the votes being transmitted directly to the three servers, namely the Municipal Board of Canvassing Server, the Comelec Server and the Transparency Server, the results were first coursed through "Queue Servers".
> (...)
>
> Ever since the camp of Marcos made the disclosure about the existence of the "Queue Servers" last May, both the Comelec and Smartmatic have been tight-lipped on its existence.
>
> However, during the clarificatory hearing at the Manila Prosecutors' Office on the complaint for violation of the Cybercrime Law filed by former Abakada representative Jonathan de la Cruz against Smartmatic and Comelec personnel, Garcia admitted that there existed a "meet me room" where the several servers were located.
> (...)
>
> Rodriguez said the admission of the existence of several other servers in the AES validated their earlier contention that indeed Smartmatic was not forthright about the details of the system it employed during the elections, putting the integrity of the May elections under a cloud of doubt.
>
> Simply stated, the election results which were broadcast to the public did not come directly from the transparency servers, as mandated by law.
>
> Instead, the results were first transmitted to a "Queue Server" where they were "consolidated and processed" and it was this "Queue Server" that sent the data to the so-called transparency servers.

In a few words, as reported by several Philippine media, in these other elections a new unforeseen event occurred that apparently undermined the security that this voting system was supposed to offer (see Figure H.2).

3. Soros is a financial speculation magnate who, through the Open Society Foundation, has promoted his very particular vision of "the open society". The original idea of "the open society" was developed by his mentor, Karl Popper, in the book *The Open Society and Its Enemies*. By 2016 Malloch-Brown had already been appointed vice president of the Quantum Fund, Soros Fund Management and the Open Society Institute, important Soros-linked organizations. In 2021 he was appointed president of the Open Society Foundation.
4. The "meet me rooms" are rooms where servers that exchange data are hosted.
5. Queue servers are servers used to manage data traffic before it reaches the destination server.

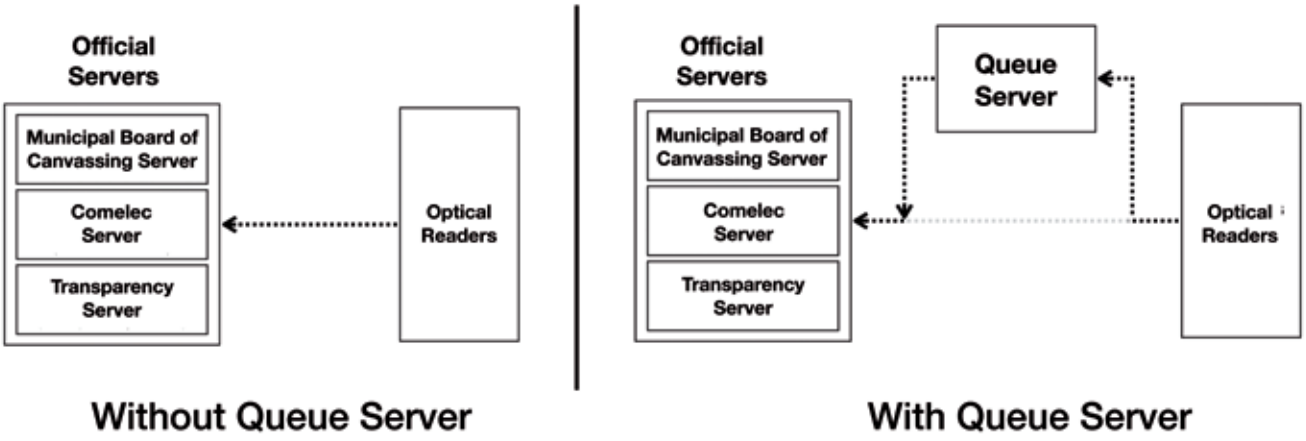


Figure H.2. The image above shows two network topologies to total the results reports. On the left without queue server; the results go directly from the optical readers to the official servers. On the right another with a queue server, which would help regulate data traffic. In the latter, the results sent by the optical readers, before reaching the official servers, pass through the queue server (note that with this topology the reliability offered by the system will depend on the controls to which the queue server is subjected).

A meme with a lot of past

Just after the 2020 US Presidential Election, a meme went viral that showed with some irony, how in the State of Wisconsin, a group of votes sent by mail that had arrived at the collection centers at dawn the day after the vote, they reversed the result of the election (see Figure H.3).

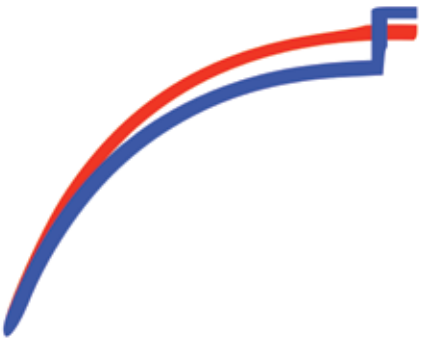


Figure H.3. This meme shows in red how the Republican party votes evolved and in blue how the Democratic party votes evolved.

A good part of the US population was very suspicious of this way of flipping the results, especially the highly differentiated behavior between the two groups of votes; the votes in person and the votes by mail. Unlike what happened in the case of the Real Madrid C.F. elections, on this occasion there was a fact that made it possible to explain such a difference: as a result of COVID, one candidate had called to vote in person and the other had called to do it by mail. If something like this had not happened, such a difference between voting in person and voting by mail would have been impossible to justify (see Figure H.4).

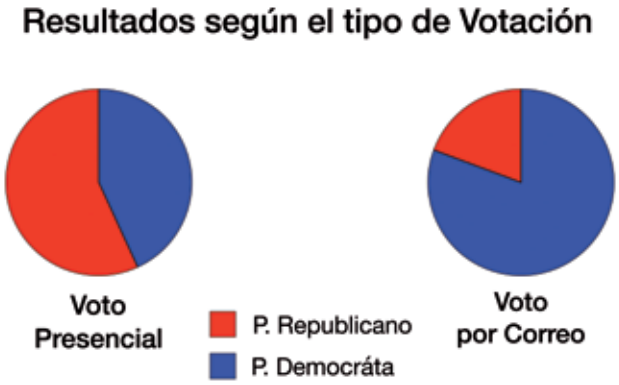


Figure H.4. Example of in-person and mail voting with different results..

This was not the first time in recent years that when totaling the results reports, at the last minute the results of an election were overturned. Below are three examples.

1. Presidential Elections of Bolivia in 2019

In the Presidential Elections of Bolivia, the then President of that nation, Evo Morales, participated, who aspired to be re-elected in the first round. The vote was manual but the transmission of the results was electronic. Until the moment that 81% of the results reports had been totaled, Morales had not obtained the victory. The opposition technicians present in the computer room of the Bolivian electoral body documented how at that moment there was a peak in the number of results reports that entered (electronically) into the system and how, from that moment on, the results of the minutes that began to enter, produ-

ced a sudden change in trend that finished giving Morales the victory. This fact was noted in the Organization of American States (OAS) preliminary report [Ref. 9] (see Figure H.5).

When these striking facts became known, strong citizen protests were unleashed that motivated the OAS to conduct an in-depth and *a posteriori* audit of the voting system. In it, a network of hidden computers designed to selectively and remotely adulterate the results of the election was discovered. This is how the OAS final report [Ref. 10] describes it:

> Introduction of unforeseen servers in the technological infrastructure (servers called BO11 and BO202), to which the TREP information flow was intentionally diverted. To redirect the flow to the BO20 server, the IP to which the 350 machines used in the SERECI were directed was modified. (...) The parallel and uncontrolled technological scheme that was deliberately created facilitated an environment that allowed the manipulation of data, the theft of records or any maneuver, facilitated by the volatility of the digital evidence.

The opportune intervention of the OAS put an end to the permanence of Evo Morales in power.

In these elections, an official body, the OAS, revealed that electoral fraud is not a myth but a reality and that it can be astonishingly technical, so much so that those who conduced it can change the results electronically, selectively and remotely (see Figure H.6)[6].

2. 2017 Presidential Elections in Ecuador

As in the case of Bolivia 2019, in these elections the vote was manual and the transmission of the results was electronic. Shortly after his defeat was announced, the opposition candidate, Guillermo Lasso, in a *CNN en Español* program [Ref. 11], narrated a strange event that had happened in this election:

> Now, what happened on Sunday? An electoral blackout. What happened? Just like when the criminal assaults you in the dark, he looks for the darkest space to assault you; here there was a blackout in the system of the website of the National Electoral Council. Prior to the blackout, only 20% of the votes had been counted and the trend was very clear according to the exit poll. It happened that there is a blackout and when they reinstall the system, oh surprise, 70% of the votes had already been counted in 20 minutes, that is, a total of 90%, and the trend strangely changed.

3. Presidential Elections of April 20132 in Venezuela

In Venezuela, after the death of Hugo Chavez was announced, a presidential election was called. This was done with the Smartmatic electronic voting system and the official results gave the ruling party candidate, Nicolas Maduro Moros, the winner by a margin of 1.49%. On November 13th, 2014, Roberto Picón, who had been commissioned by the opposition sector to coordinate the defense of the vote, presented the report "Sistema Electoral Venezolano (1999-2014)" (Venezuelan Electoral System (1999-2014)) at the Universidad Católica Andrés Bello (UCAB) [Ref. 12]. In one of the sheets of the annexes to this report, a graph is included that shows an abrupt peak, close to 7:30 PM, in the number of tally sheets per minute that entered the server where the results were totaled (see Figure H.7).

6. Shortly after the OAS published its final report on these elections, an attempt was made to disqualify its expert opinion with an "argument of authority." On February 27th, 2020, the Washington Post published the article Bolivia dismissed its October elections as fraudulent. Our research found no reason to suspect fraud. In it, two researchers linked to the Massachusetts Institute of Technology (MIT) contradict the OAS report with pseudo-scientific arguments. The fact that it was written by two researchers associated with such a prestigious university caused quite a stir. So much that at times it shook the credibility of the OAS and that of its Secretary General. A few days after its publication, the Massachusetts Institute of Technology, through a letter from its rector Rafael Reif, distanced himself from this study and explained that "Although the two authors are staff members of the MIT Election Data and Science Data Lab, conducted the project that they describe as independent contractors of the Center for Economic and Politics Research (CEPR)". The CEPR is an organization based in Washington, an assiduous defender of the Chavismo and the Venezuelan government. In the case of Bolivia, with the response of the rector Rafael Reif, this argument of authority was distorted and thus the OAS report was vindicated (see article "La Verdad", March 5th, 2020, El Mundo newspaper, Spain).

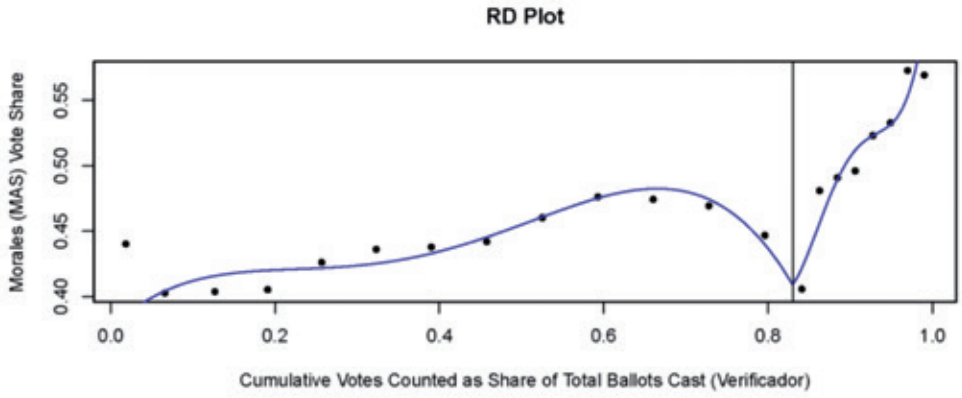


Figure H.5. Graph taken from the OAS Preliminary Report [Ref. 9] where it becomes evident how the votes that entered in the end produced this change of trend that gave Morales the victory in the first round.

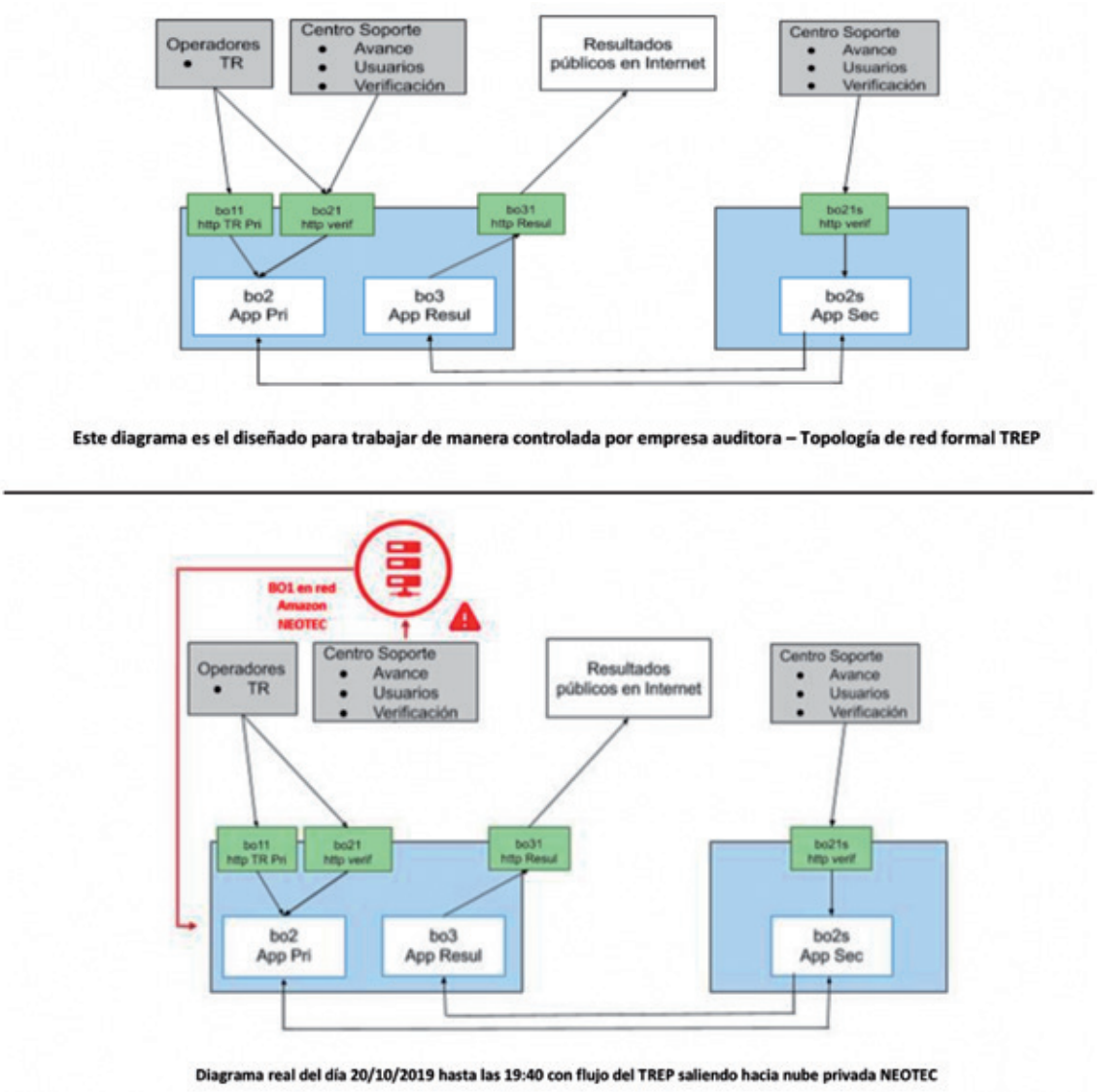


Figure H.6. Images taken from the OAS Final Report that show the data flow diagrams for the totalization of the electoral results. Left as it should be. Right the found.

In the following sheet of this same report there is a graph that shows how the tally sheets that entered from that same hour turned the result of the election upside down. And it asks the following question:

> Why did the voting tables that ended up giving NMM [Nicolas Maduro Moros] the victory broadcasted after 7:30 PM?

It is well worth to make a good effort to answer this question.

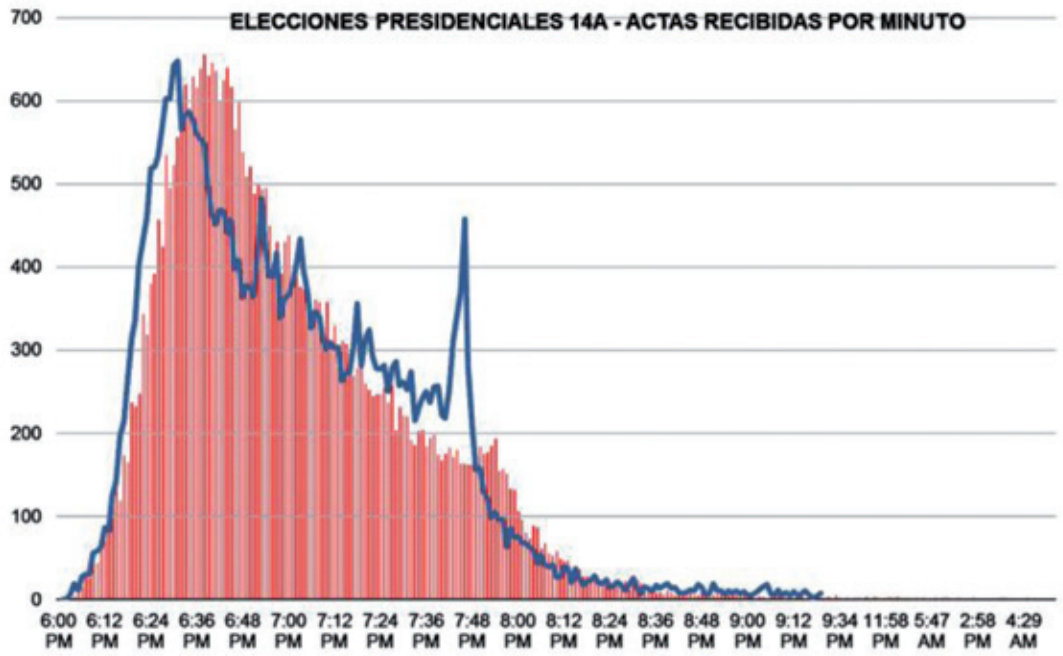


Figure H.7. Image taken from Ref. 12 showing in blue the number of electronic results reports per minute that entered the system that totaled the results sent by the voting machines (according to the data collected by the opposition technicians who were present in the room where these were totaled). Note the spike that occurred shortly after 7:30 p.m.

Voting machines and connectivity

In November 2014 Dominion Voting Systems, Inc. was granted patent 8876002 for a system that serves to facilitate storage and tracking of voting machines. Justia.com's summary of it says [Ref. 13]:

> A system includes a host computer, a plurality of voting machines that are connected via a network to the host computer, each voting machine having one or both of a wireless communication device and a data port that is coupled to the host computer. The system also includes an election and voting machine preparation portion included in the host computer to manage and/or control the connected voting machines.

One of the inventors of this patent had worked first on Smartmatic and then on the Sequoia Voting System. Another had worked at Sequoia. Given that Smartmatic bought Sequoia in 2005 and years later Dominion bought it, this could be interpreted as a kind of continuity of work that should not attract attention. What should be cause for concern is that the voting machines include an internal device that allows them to interact in real time with any external server. This introduces a major vulnerability into the system; during the voting the machines could supply information that could be misused or could even be maliciously intervened from outside (see Figure H.8).

In January 2020 *NBC News* published an investigation *'Online and vulnerable'*: *Experts find nearly three dozen U.S. voting systems connected to the internet*, by Kevin Monahan, Cynthia McFadden and Didi Martínez [Ref. 14], which deals precisely with this topic; the connectivity of voting machines and its possible consequences. In it is said:

> It was an assurance designed to bolster public confidence in the way America votes: Voting machines "are not connected to the internet."
>
> Then Acting Undersecretary for Cybersecurity and Communications at the Department of Homeland Security Jeanette Manfra said those words in 2017, testifying before Congress while she was responsible for the security of the nation's voting system.
>
> So many government officials like Manfra have said the same thing over the last few years that it is commonly accepted as gospel by most Americans.
> (...)

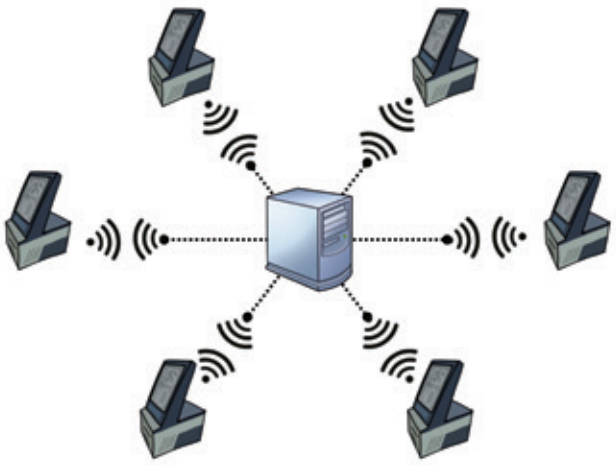


Figure H.8. Schematic of a group of voting machines connected by a wireless mechanism to a central server.

"We found over 35 [voting systems] had been left online and we're still continuing to find more", Kevin Skoglund, a senior technical advisor at the election security advocacy group National Election Defense Coalition, told NBC News.

"We kept hearing from election officials that voting machines were never on the internet," he said. "And we knew that wasn't true. And so we set out to try and find the voting machines to see if we could find them on the internet, and especially the back-end systems that voting machines in the precinct were connecting to report their results."
(...)

The three largest voting manufacturing companies —Election Systems & Software, Dominion Voting Systems and Hart InterCivic— have acknowledged they all put modems in some of their tabulators and scanners. The reason? So that unofficial election results can more quickly be relayed to the public. Those modems connect to cell phone networks, which, in turn, are connected to the internet.

The largest manufacturer of voting machines, ES&S, told NBC News their systems are protected by firewalls[7] and are not on the "public internet." But both Skoglund and Andrew Appel, a Princeton computer science professor and expert on elections, said such firewalls can and have been breached.
(...)

For election systems to be online, even momentarily, presents a serious problem, according to Appel. "Once a hacker starts talking to the voting machine through the modem, the hacker cannot just change these unofficial election results, they can hack the software in the voting machine and make it cheat in future elections," he said.
(...)

ES&S confirmed they had sold scanners with wireless modems to at least 11 states. Skoglund says those include the battleground states of Michigan, Wisconsin and Florida.

While the company's website states that "zero" of its voting tabulators are connected to the internet, ES&S told NBC News 14,000 of their DS200 tabulators with online modems are currently in use around the country.

T

7. Barriers to access a private network.

Testimonials so disruptive that many prefer to ignore them

Boomerang Chavez

In 2015 the book *Bumerán Chávez: los fraudes que llevaron al colapso en Venezuela* (Bumeráng Chávez: the frauds that led to the collapse in Venezuela) [Ref. 15] was published. Its author, the Spanish journalist Emili J. Blasco, dedicates it with these words: "To the unbelievers. We all, at some point, were".

Throughout his book, Blasco collects the testimonies of Leamsy Salazar, a military man who had belonged to the innermost security ring of the Chavismo and who had become a protected witness for the DEA8. It reveals the details of the handover of the sovereignty of Venezuela to the Cuban regime, of economic corruption, of the drug state, of the links of the Chavez government with Islamic radicalism and of electoral deceit.

In Chapter 3 *Es verdad, añadimos votos falsos* (It is true, we added false votes) dedicated to the issue of electoral fraud, it says:

> The secret computers of the Chavistas indicated it very clearly. At six o'clock in the afternoon, the time that this April 14th, 2013, the electoral centers in Venezuela had to close, the presidential elections had been won by Henrique Capriles Radonski...
>
> An official parallel computer system to the official one allowed the Chavismo to know in real time throughout the day the evolution of the vote and enabled it to know the number of false votes that it had to produce to spin the result.

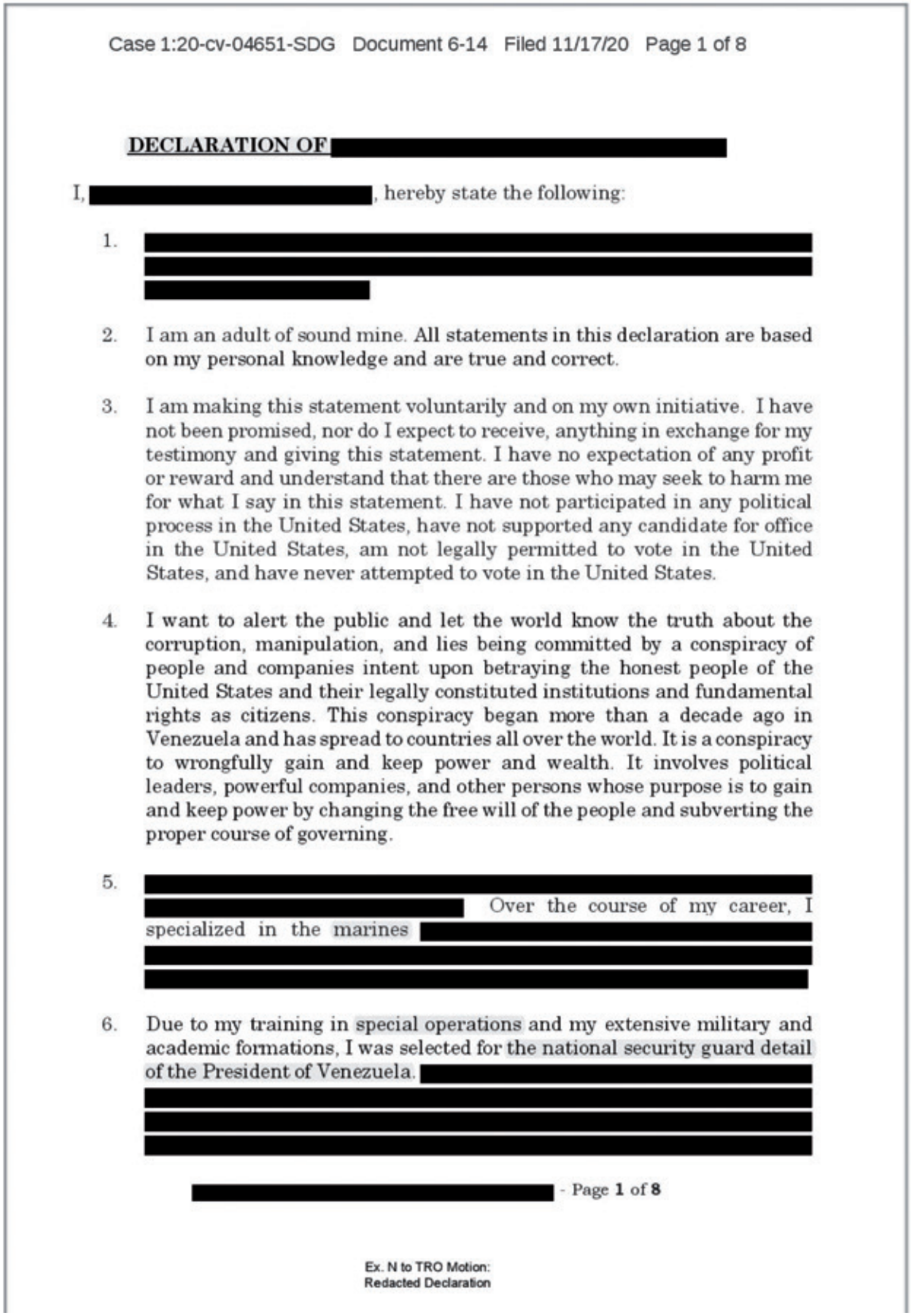
The election referred to here is the same that was commented in the section "A meme with a lot of past", in which the results that entered the totalization system from 7:30 PM turned the result around and gave the victory to Nicolas Maduro Moros.

USA 2020

Shortly after the 2020 US presidential election an affidavit was released stating (see Ref. 16):

> I want to alert the public and let the world know the truth about the corruption, manipulation, and lies being committed by a conspiracy of people and companies' intent upon betraying the honest people of the United States and their legally constituted institutions and fundamental rights as citizens. This conspiracy began more than a decade ago in Venezuela and was spread to countries all over the world. It is a conspiracy to wrongfully gain and keep the power wealth.
> (...)
>
> I was witness to the creation of operation of a sophisticated electronic voting system that permitted the leaders of the Venezuelan government to manipulate the tabulation of votes for national and local elections and select the winner of those elections in order to gain and maintain their power.

8. Acronym in English for the Drug Enforcement Administration, an agency of the United States Department of Justice.



Case 1:20-cv-04651-SDG Document 6-14 Filed 11/17/20 Page 1 of 8

DECLARATION OF [redacted]

I, [redacted], hereby state the following:

1. [redacted]

2. I am an adult of sound mine. All statements in this declaration are based on my personal knowledge and are true and correct.

3. I am making this statement voluntarily and on my own initiative. I have not been promised, nor do I expect to receive, anything in exchange for my testimony and giving this statement. I have no expectation of any profit or reward and understand that there are those who may seek to harm me for what I say in this statement. I have not participated in any political process in the United States, have not supported any candidate for office in the United States, am not legally permitted to vote in the United States, and have never attempted to vote in the United States.

4. I want to alert the public and let the world know the truth about the corruption, manipulation, and lies being committed by a conspiracy of people and companies intent upon betraying the honest people of the United States and their legally constituted institutions and fundamental rights as citizens. This conspiracy began more than a decade ago in Venezuela and has spread to countries all over the world. It is a conspiracy to wrongfully gain and keep power and wealth. It involves political leaders, powerful companies, and other persons whose purpose is to gain and keep power by changing the free will of the people and subverting the proper course of governing.

5. [redacted] Over the course of my career, I specialized in the marines [redacted]

6. Due to my training in special operations and my extensive military and academic formations, I was selected for the national security guard detail of the President of Venezuela. [redacted]

[redacted] - Page **1** of **8**

Ex. N to TRO Motion:
Redacted Declaration

Figure H.9. First page of the affidavit attributed to Leamsy Salazar

> Importantly, I was a direct witness to the creation and operation of an electronic voting system in a conspiracy between a company known as Smartmatic and the leaders of conspiracy with the Venezuelan government. This conspiracy specifically involved President Hugo Chavez Frías, the person in charge of the National Electoral Council named Jorge Rodriguez, and principal, representatives, and personnel from Smartmatic... (...)
>
> After Smartmatic created the voting system President Chavez wanted, he exported the software and system all over Latin America. (...)
>
> I want to point out that the software and fundamental design of the electronic electoral system and software of Dominion and other election tabulating companies relies upon software that is a descendant of the Smartmatic Electoral Management System. In short, the Smartmatic software is the DNA of every vote tabulating company's software and system.

When this affidavit was made public, part of the information was edited, including the name of the person who made it. However, based on what was published, almost immediately afterwards several journalists attributed it to Leamsy Salazar (see Figure H.9).

These seven stories serve to motivate us to enter the world of mathematics and from there to decipher the electronic voting system that Chavismo imposed in Venezuela and that later spread throughout the world.

SECTION 1

HOW SCIENCE WORKS: THE COUNTERPOSITION OF ARGUMENTS

1.1. Galileo and the opposition of antagonistic models

Before start analyzing this case study, it is worth remembering the role that the contrast of models has had in the development of science. Perhaps the best example of this is the book of Galileo Galilei, *Dialogo sopra i due massimi sistemi del mondo.* In it, three characters reason over which of the two prevailing models of celestial mechanics at that time was the false and which was the true one. *Simplicio* advocates the Ptolemaic model, the one that Aristotle had maintained and that was the commonly accepted. *Salviati* for his part defended an opposite model, the Copernican. *Sagredo*, new to the subject but intelligent, represents the neutral vision of someone who seeks the truth (see Figure 1.1).

Throughout this book, *Simplicio* and *Salviati*, starting from of the model that each one of them defended, try to explain the reason for a series of facts that could be observed in nature: the phases of Venus, the movements of the sunspots, the shadows of the mountains on the Moon, the size of the "new" stars that the telescope just allowed to see, the moons of Jupiter and the tides. These were all facts that with a simple observation could be verified. At the end of the book it becomes clear that if the ptolemaic model were true, explaining each of these facts would be extremely complex and physically implausible. On the other hand, if the copernican model were used, all these facts could be explained in a relatively simple and physically plausible way. Thanks to the diffusion that this work had in the countries where it was not censored, the Ptolemaic model was discarded and the Copernican model became the commonly accepted one (see Figure 1.2).

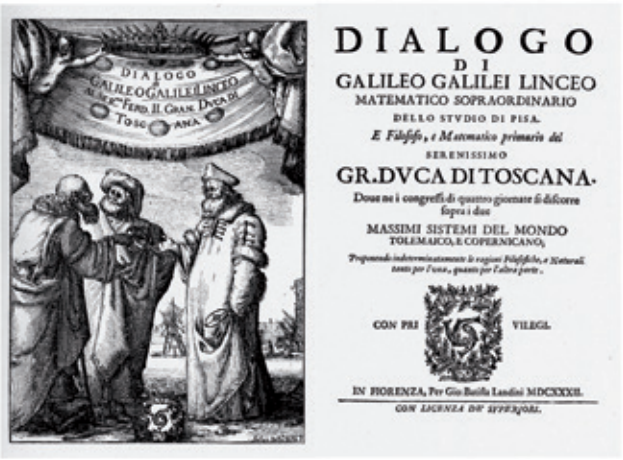

DIALOGO
DI
GALILEO GALILEI LINCEO
MATEMATICO SOPRAORDINARIO
DELLO STVDIO DI PISA.
E Filosofo, e Matematico primario del
SERENISSIMO
GR.DVCA DI TOSCANA.
Dove ne i congressi di quattro giornate si discorre sopra i due
MASSIMI SISTEMI DEL MONDO
TOLEMAICO, E COPERNICANO,
CON PRI VILEGI.
IN FIORENZA, Per Gio: Batista Landini MDCXXXII.
CON LICENZA DE' SUPERIORI.

Figure 1.1. Frontispiece of the first edition.

This mechanism of opposing antagonistic models consists of observing and verifying facts that occur in nature related to a specific topic and then engaging in a kind of battle between the different models or hypotheses that claim to be true. The model or models from which these facts can be explained with plausible arguments remain, the others are discarded.

The *Dialogue* for the methodology he used became one of the main references of the scientific method and the philosophy of science. Years after writing it and already imprisoned in his house in Tuscany, Galileo wrote *Discorsi e dimostrazioni matematiche intorno a due nuove scienzi*. In it he used the same method and even the same characters that he had used in the *Dialogue* to dismantle Aristotelian mechanics, a theory in which he had believed and taught. He contrasted it with other mechanics that he himself, after years of multiple observations, had begun to structure. The ideas that he exposed in this other book were, in a certain way, the precursors of infinitesimal calculus and Newtonian mechanics (see Figure 1.3).

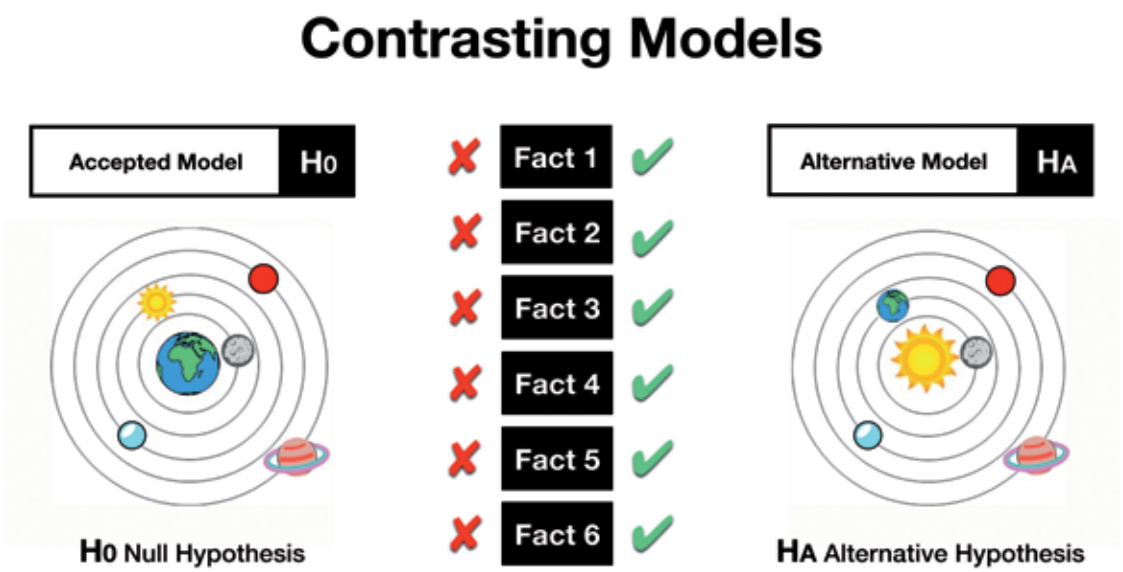


Figure 1.2. The ptolemaic model of the Universe (on the left) holds that the Sun and the rest of the celestial bodies revolved around the Earth, and that the Earth was the center of the Universe. This was the accepted model. The copernican model (on the right) holds that the Earth is not the center of the Universe and that it and the rest of the planets revolve around the Sun. There are several facts that the ptolemaic model cannot explain and the copernican model can.

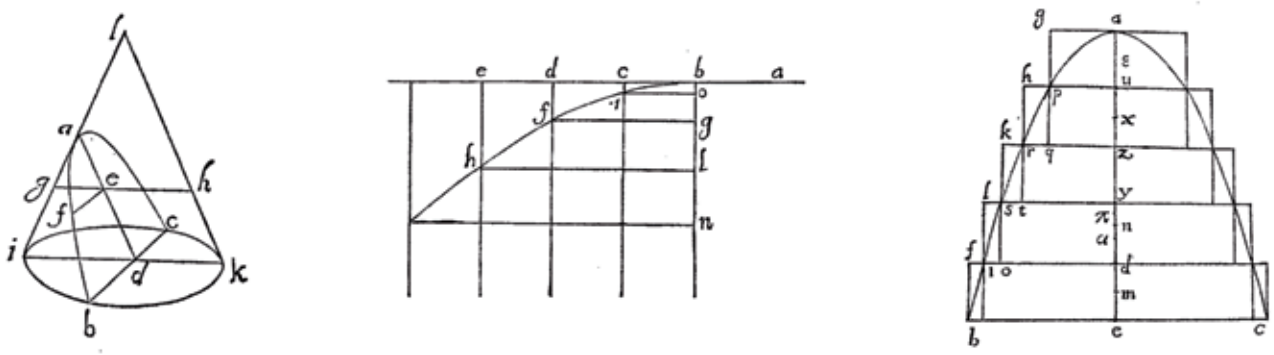


Figura 1.3. Images of Discorsi e dimostrazioni matematiche intorno a due nuove scienzi that anticipated infinitesimal calculus and Newtonian mechanics.

1.2. “Plausible explanation”: a relative concept, but to some extent

One of the problems with this mechanism of opposing arguments is that in a certain way the concept of “plausible explanation” is something relative; what may seem a plausible explanation to some people may seem absurd to others, but the relativization of this concept seems to have a limit. To illustrate this, two discussions that are taking place these days, also related to celestial mechanics, are shown.

The Big Bang Theory

Today, as a result of the latest images obtained by the Webb telescope of the background of the Universe, there is a very interesting discussion between those who maintain that these images can be explained by the Big Bang Theory and those who claim that they cannot. Well-structured arguments are being presented on both sides.

The Terraplanists

Far removed from the previous discussion is that of the terraplanists. They emphatically deny any evidence that contradicts the model of the Universe that they hold. Furthermore, they ensure that from it they can explain by plausible arguments everything that can be observed: the reason for day and night, the reason for the seasons, the reason for eclipses, etc.

These two cases seem to indicate that the concept of “plausible explanation” is relative, but to a certain extent.

1.3. Why and how to apply the method of contrasting arguments in the present case of study

The electronic voting system on whose operation this case study focuses has been the center of many discussions and conflicts for years. After its debut, in the 2004 Presidential Recall Referendum in Venezuela, a large part of Venezuelans felt that this system had been imposed by the Chavismo to, through electoral fraud, remain in power. This happened despite the fact that the electoral observation groups that had been invited by the National Electoral Council of Venezuela (CNE) to observe this referendum, the Carter Center, the Organization of American States (OAS) and *Ojo Electoral*[9], endorsed the results that this voting system had given. This latest version of the events, which were given by these electoral observers, is the one that has been accepted by the institutions and international organizations, nations and even by the spokesmen of the Venezuelan opposition.

For many years in Venezuela this voting system continued to be used. Its results continued to be endorsed and taken as good. Despite this, over the years, two contrasting visions of its performance were built. One that supports it; which ensures that this system does not change the results. This is the vision that until now has served as official truth. The other considers that this system is a deliberately opaque mechanism, which was imposed by the Chavismo to carry out massive electoral fraud and thus perpetuate itself in power. World public opinion and the Venezuelan political establishment (government and opposition) have taken it as good for years, despite this the majority of Venezuelans perceive it as fraudulent (see Figure 1.4).

In the present case study, as in the discussion that arose during the Renaissance about celestial mechanics, there is a series of duly documented verifiable facts and two opposing views that should be able to explain them. Let us see in the subsequent sections whether one of them fails to explain them and the other does. If so, one of these visions should be discarded and the other, opposing and complementary (one is the negation of the other), accepted[10].

9. The Carter Center (a foundation directed by Jimmy Carter, former U.S. President) and the OAS had extensive experience in electoral observation. Ojo Electoral was a newly formed grouping of Venezuelans.

10. What is usually done in science is to discard all those visions, models or theories from which the observed facts cannot be explained with plausible arguments.

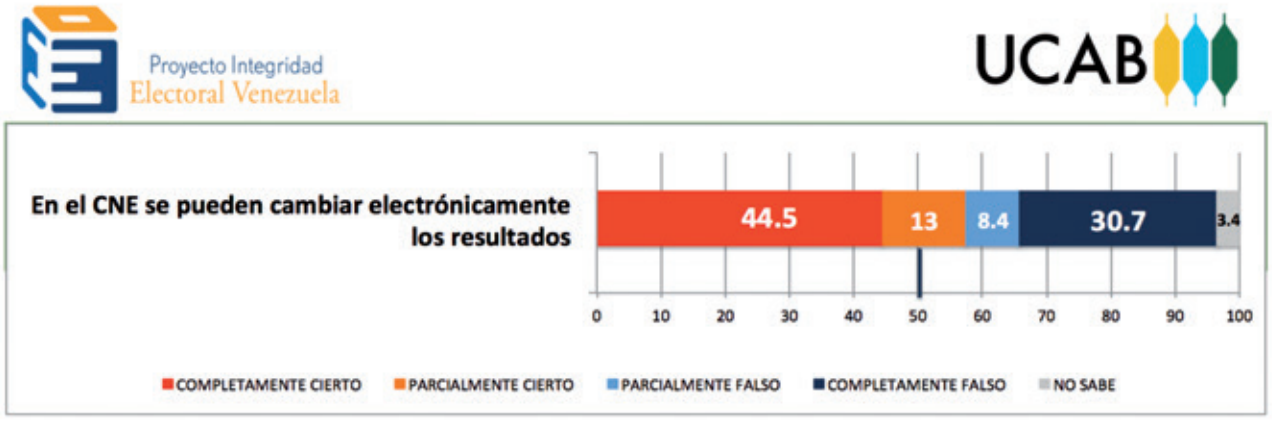


Figure 1.4. Image taken from the study Percepciones ciudadanas del Sistema Electoral Venezolano (Citizen Perceptions of the Venezuelan Electoral System) carried out in 2015 by the Venezuela Electoral Integrity Project of the Andrés Bello Catholic University (UCAB) [Ref. 17]. It was found that 44.5% of Venezuelans believe that it is completely true that the National Electoral Council of Venezuela (CNE) can electronically change electoral results, while 30.7% believe that this is completely false. These two antagonistic and generalized perceptions about the performance of the electronic voting system imposed by Chavismo in Venezuela began since its debut in 2004.

SECTION 2

EVIDENCE OF ELECTORAL FRAUD BASED ON CONNECTIONS AND DEGREES OF SEPARATION

2.1. Crimes, connections and degrees of separation

When a crime occurs, a series of events usually occur that had it not existed, both its occurrence and the way in which they are connected to each other would be practically impossible to explain. The probability that each of them would have occurred by chance would have been extremely low; however, they all occur and concur over time in such a way that enable the realization of the crime. One of the things that happen with these events is that "the degree of separation" between those who participate in them is unjustifiably low[11]. These relationships and these degrees of separation can be visualized and analyzed with a graph diagram. When these events and the degrees of separation between their authors can hardly be explained as a consequence of chance, they become part of the accumulation of evidence[12].

11. This mechanism to reveal crimes was indirectly proposed in the Democracy Chapter of the NUMB3RS Series (advised by Wolfram Research). Later it was explained by the Department of Mathematics at Cornell University <http://pi.math.cornell.edu/~thru/numb3rs/318.html >
12. When a murder occurs, there is usually no direct record that the alleged murderer fired a gun and that the bullet that ejected from it fatally wounded the victim. What crimes usually leave behind is a series of facts that become evidence or an accumulation of indications. Based on these the judge or the jury, to give a verdict, they choose between several hypotheses that in the end they should opt for those that best managed to explain the observed facts.

2.2. Backgrounds to the establishment of the electronic voting in Venezuela

Lieutenant Colonel Hugo Chavez made himself known on February 4th, 1992 when he was part of a military coup that tried to overthrow the democratic government of Carlos Andrés Pérez. This failed and Chavez was arrested. In 1994 his cause was dismissed, for which he was released and enabled to pursue a political career. In 1998, he ran as a candidate for the Presidency of the Republic of Venezuela and in December of that year he won the elections.

On February 2nd, 1999, the same day he was sworn in as President of the Republic, Chavez activated what was known as the Constituent Process. Venezuelans voted to choose the members of a National Constituent Assembly (NCA) to be in charge of drafting a new National Constitution. Chavez, advised by two mathematicians, with 52% of the votes obtained 126 of the 131 members of this assembly.

During its installation, the NCA declared itself "depository of the will of the people and expression of its sovereignty, with the attributions of the Original Power to reorganize the Venezuelan State" and resolved "that it may limit or decide the cessation of the activities of the authorities that constituted the Public Power". For well-known Venezuelan jurists, this decree was a true coup d'état (see article *Asamblea Constituyente de 1999, Medio 'idóneo' para subvertir la democracia: una estrategia bien planificada* (Constituent Assembly of 1999, 'Suitable' means to subvert democracy: a well-planned strategy) by Marisol Sarría Pietri, [Ref. 18].

Within a few months, in addition to having drafted the new Constitution, the CNA had : 1) eliminated the Supreme Court of Justice, which it replaced with the Supreme Tribunal of Justice (STJ) (appointing its magistrates hand-picked), 2) suppressed the Congress of the Republic and created the Legislative Commission of the National Constituent Assembly, to which they attributed the power to legislate (appointing its members hand-picked) , 3) designated hand-picked the Comptroller General of the Republic, the Attorney General of the Republic and a new directive for the National Electoral Council (CNE) and 4) created "El Congresillo" (The small Congress), a collegiate body to which they transferred their supra-constitutional powers (appointing its members handpicked).

In August 2003, when the opposition was already organizing to request the CNE to call a presidential recall referendum[13], the TSJ (appointed by the NCA) intervened and designated hand-picked another new leadership for the CNE. It did not take long for this to be perceived as a clear 3 to 2 unconditional in favor of the Chavismo. A few months after its installation, it decided (by a vote of 3 to 2) to replace the automated system of optical readers with which votes had been counted since 1998 (ballots) in Venezuela with a voting system that was being developed by the SBC Consortium. (Smartmatic, Bizta and CANTV).

The image in Figure 2.1 summarizes this schematically.

Let us begin by listing chronologically some of

13. This legal figure was contemplated in the Constitution.



Figure 2.1. The NCA declares itself “Original Power”, handpicks the STJ, the STJ handpicks the CNE and the CNE imposes the electronic vote, and this directive imposed electronic vote and chose the SBC Consortium to implement.

2.3. The development of the electronic voting system of the SBC Consortium and its relationship with the Chavez government

the events that relate to the automation of voting in Venezuela, including the connections between the SBC Consortium, the Venezuelan government, and the preparations for the 2004 referendum in Venezuela:

- December 1998: The votes that for years had been on ballots that were counted by hand, began to be counted by optical readers manufactured and programmed by the American company Election Systems & Software (ES&S).
- January 2000: The "Mega-Elections" are scheduled for May 28th. In them, by decision of the ANC, all popularly elected positions should be re-elected, including that of President of the Republic. The body in charge of organizing them was the CNE (whose board of directors has just been hand-picked by the CNA).
- March 2000: On the 30th, a young Venezuelan engineer, Antonio Mugica, applied to the US Patent and Trade Office for the use of two trademarks: Bizta and Smartmatic[14].
- May 2000: The STJ suspends the holding of the "Mega-Elections" and they are postponed to July 30th. A few days later, "El Congresillo" handpicked a new leadership for the CNE.
- July 2000: The Mega-Elections are made with the optical readers manufactured by ES&S, but not programmed by ES&S as they were supposed to be on May 28th, but programmed by the Spanish company Indra. Chavez is re-elected President of the Republic.
- May 2003: In the so-called Negotiation and Agreement Table (government, opposition, Carter Center and OAS) it was decided that the serious political problems that Venezuela was experiencing should be resolved through a presidential recall referendum.
- June 2003: The Venezuelan State, through the National Industrial Credit Fund (FONCREI) and the company Sociedad de Capital de Riesgo (SCR), becomes the largest shareholder of Bizta.
- August 2003: The Supreme Court of Justice, under the control of Chavez, handpicks another board for the CNE.
- November-December 2003: In a 4-day event, regulated and supervised by the CNE, the Venezuelan opposition obtains the number of signatures necessary to activate the call for a presidential recall referendum.
- January 2004: A senior official from the Chavez government from the Ministry of Science and Technology, Omar Montilla Castillo, is appointed director of Bizta. Omar Montilla, the father of Omar Montilla Castillo, had been secretary of Chavez in the Council of Ministers.

14. Events concerning the relationship between Bizta and Smartmatic, and Bizta and the Venezuelan State were uncovered and published prior to the referendum by *The Miami Herald*'s investigative journalists Richard Brand and Alfonso Chardy.

- February 2004: Jorge Rodriguez, who would eventually become vice president of the Chavez government and later secretary general of the PSUV, the ruling party, leads a tender in which the SBC Consortium is chosen to be in charge of developing and supplying the new automated voting system that from then on would be used in Venezuela (Smartmatic would provide the hardware, Bizta the Software and CANTV, the Venezuelan telephone company, its communication networks).
- April 2004: Manufactured by Olivetti under instructions from Smartmatic, the first batch of voting machines arrives in Venezuela.
- June 2004: On the 3rd, in a public speech, Chavez accepts the holding of the Presidential Recall Referendum. On the 21st, Jorge Rodriguez proposed to the CNE board of directors the purchase of the biometric identification system or fingerprint capture. His proposal is immediately approved.
- August 2004: In the Presidential Recall Referendum, this new voting system makes its debut and the official results give Hugo Chavez the victory.

The Figure 2.2 shows how the events related to the Chavez government with the development of this voting system are represented in a graph diagram.

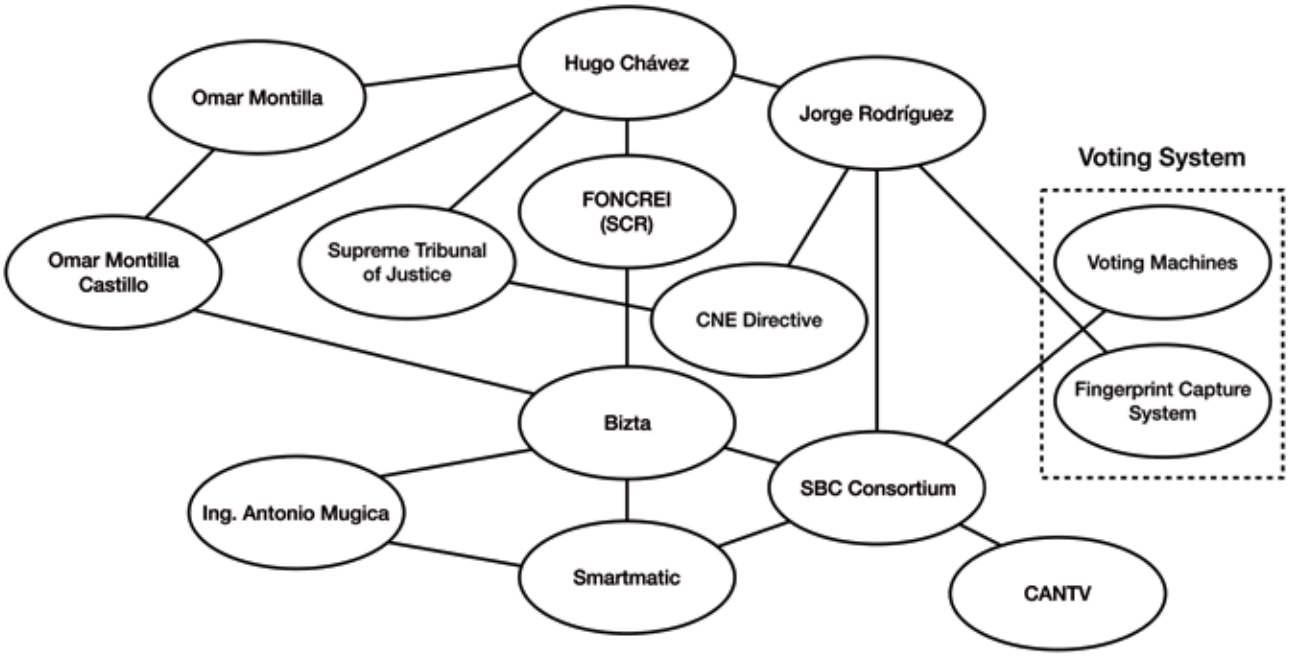


Figure 2.2. Graph diagrams consisting of nodes and connections. One of the most important variables to observe is the number of connections that reach each node; this gives us an idea of the relevance of each node. Another variable to consider is the degree of separation between nodes. The figure above shows the graph diagram of the relationship between the development of the SBC Consortium's electronic voting system and the Chávez government.

2.4. Counterposition of arguments about the reason for the investment of the Venezuelan State in Bizta

Regarding what happened in the 2004 referendum there are still two opposing hypotheses today:

> Hypothesis A: In the 2004 referendum in Venezuela, voting machines were not used to perpetrate electoral fraud. The results they reported were true.
>
> Hypothesis B: In the 2004 referendum in Venezuela, voting machines were used to perpetrate electoral fraud. The results they reported were fraudulent.

Let us see more about the relationship between the Chávez government and the development of the SBC Consortium's voting system and how this one, from each of these hypotheses has been or could be explained.

> On May 28th, 2004 *The Miami Herald* published the article *Venezuela Owns Stake in Ballots* [Ref. 19], by Richard Brand and Alfonzo Chardy, the two investigative journalists who discovered this plot. In it is said:
>
> A large and powerful investor in the software company that will design electronic ballots and record votes for Venezuela's new and much criticized election system is the Venezuelan government itself, The Herald has learned.
>
> Venezuela's investment in Bizta Corp., the ballot software firm, gives the government 28 percent ownership of the company it will use to help deliver voting results in future elections, including the possible recall referendum against President Hugo Chavez, according to records obtained by The Herald.
> (...)
>
> Pro-Chavez government officials and company executives interviewed by The Herald say the Smartmatic-Bizta machines are among the most secure in the world, and that the government's investment in Bizta was unrelated to Bizta's bid for the voting machine contract.
> (...)
>
> Until a year ago, the Bizta Corp. was a struggling Venezuelan software company with barely a sales deal to its name, records show. Then, the Venezuelan government - through a venture capital fund - invested about $200,000 and bought 28 percent of it.
>
> The government's investment in Bizta made Venezuela Bizta's largest single shareholder and, ultimately, its most important client.
>
> The decision to replace the $120 million system built by Omaha-based Election Systems & Software was made Feb. 16 under unusual circumstances. Two of the five National Electoral Council members sympathetic to the opposition complained that they had been largely shut out of the process.
> (...)
>
> According to Bizta's 2002 financial statement, the most recent one filed by the company in Venezuela, it was then a dormant firm that had no sales and was slowly losing money.

In June 2003, however, a venture capital company called Sociedad de Capital de Riesgo (SCR) invested about $200,000 in Bizta. The SCR is owned by the Venezuelan government Industrial Credit Fund.

In January, a top official in Venezuela from the science ministry, Omar Montilla, joined Bizta's board of directors to represent the government's three million shares, records show.
(...)

One month after Montilla joined the board, the National Electoral Council awarded Bizta and partners Smartmatic and CANTV the $91 million contract to develop new voting machines. Bizta was hired to write the electronic code that configured the names and parties of candidates on the touch screens. Smartmatic would build and design the machines. CANTV, the publicly held phone company, would provide the phone lines for the system and election-day technical support.

The venture is largely the work of two little-known Venezuelan engineers: Antonio Mugica Rivero and Alfredo Anzola Jaumotte, childhood friends and recent engineering school graduates.

Mugica, 30, is the president of Smartmatic and a founder of Bizta. Anzola, 30, is the president of Bizta and the vice president of Smartmatic, corporate records from Venezuela show.
(...)

When told in a subsequent interview in Caracas that Bizta papers showed the government had an investment in his company through SCR, Anzola and Mugica said they viewed the investment as a loan.

In a subsequent article by R. Brand, *Voting -System Firm Drops Venezuela as an Investor*, published June 12th, 2004 by The Miami Herald [Ref. 20], it says:

"They were caught. We discovered the fraud and now they are covering it up," said Ernesto Alvarenga, an opposition congressman. "We still have to be careful. All of this is related to the electronic fraud that they are trying to achieve."
(...)

Bizta officials said Friday they were buying back the shares, purchased for about $200,000, to address concerns about the government's influence in the company as it prepares for the critical August referendum.

"Given our current engagements, even the appearance of a conflict of interest is unacceptable, and as a result, we are repaying the ... loan and Omar Montilla is stepping down from our Board of Directors," Bizta official Eduardo Correia said in the press release.
(...)

The sudden decision also comes one day after The Herald started asking Bizta executives about Montilla's background. Montilla, the Herald learned, was an ally of Chavez who had an intricate role in his 1998 election campaign.
(...)

Montilla had been a top official in a group called UNEPAD, formed by then-presidential candidate Chavez's Patriotic Pole coalition in 1997 to monitor his first election and conduct exit polls, among other things. Most Venezuelan political parties maintain monitoring groups such as UNEPAD to protect their party interests at the polls.

While working for the Chavez campaign in 1998, Montilla was given the task of evaluating the effectiveness of electronic voting machines being used at the time, an optical scanner system built by Omaha-based Election Systems & Software, former UNEPAD members said.

As an electronic engineer, his job was to make sure that Chavez would not be cheated in the election, a former UNEPAD member said.
(...)

Government officials had repeatedly claimed that its investment in Bizta and Montilla's appointment was made without knowle-

> dge that the company would ever seek an elections-related contract.
> (...)
>
> They [government officials] also insisted the investment was part of a larger effort to help support private enterprise and its interest in a ballot software company was merely coincidental, one of a dozen such investments made to help promising companies.

If Hypothesis A were true, the probability that by chance the Venezuelan State would have become the largest shareholder of Bizta and that after a few months it would be chosen by the CNE to develop the software that would be in charge of counting the votes to Venezuelans would have been extremely low. Therefore, this fact does not have a plausible explanation under the assumption that this hypothesis was the true one.

On the other hand, if Hypothesis B were the true one, both, the investment of the government of Chavez in Bizta and the appointment of Omar Montilla Castillo as director of this company could be explained as part of the preparation of electoral fraud. And both, the return of the money to the Venezuelan government by Bizta and the way in which Omar Montilla was disincorporated from the board of directors of Bizta would correspond to the typical maneuver that those who feel discovered while preparing a crime tend to do.

For the aforementioned reasons, the investment made by the government of Chavez in Bizta, constitutes evidence or an indication against hypothesis A.

Note: Throughout this writing, when the word “evidence” is used, it is done in the sense that it is usually used in the scientific method or in statistical mathematics: “evidence” for or against this or that hypothesis.

SECTION 3

THE DEBUT OF THE VOTING SYSTEM OF THE SBC CONSORTIUM

The Presidential Recall Referendum of August 15th, 2004 was the beginning of electronic voting in Venezuela and also the debut of this voting system. Given that on that occasion those who developed it were at the lowest point of their learning curve, analyzing what happened in it is a unique opportunity to decipher how it works.

3.1. Audit of software and hardware, voting and scrutiny of the votes

The audit of the software and hardware of the voting system

The audit of the software and hardware of the voting system was performed in the days prior to the voting and was described in the Carter Center's report *Observing the Venezuela Presidential Recall Referendum* [Ref. 21]:

> University professors selected by the CNE performed an audit of the voting machine software source code. The audit was performed at the Smartmatic offices in a controlled environment to ensure there was no unauthorized distribution of the code (...) Comando Maisanta (CM) [representatives of the ruling party], Coordinadora Democrática (CD) [representatives of the opposition], and international observers did not have access to this audit. The audit scope, procedure, and documentation were not released by the CNE. The lack of access to the audit caused transparency concerns to the opposition and contributed to suspicions about the possibility of fraud in the weeks after results were announced.
>
> Smartmatic designed and executed a formal release and certification procedure on each machine. The machines were individually programmed, tested, and certified on a one-by-one basis in a warehouse controlled by the CNE with Plan República[15] guards. Again, CM, CD, and international observers did not have access to the software certification and machine preparation process, further exacerbating concerns about transparency.

Note among other things that it was the CNE itself who chose the auditors.

The voting

To vote, the voters pressed on the touch screens of the voting machines the option of their preference, "Yes" to revoke the mandate of President Chavez or "No" for him to remain in office. Immediately afterwards, the machines issued a ballot with the selected option, which was called "voting receipt". The voter received it and deposited it in a ballot box that would not be opened (see Figure 3.1).

The scrutiny of the votes

To scrutinize the votes -electronic votes- the ballot boxes were not opened, the machines were connected to the "intranet" and once the data exchange was successfully completed, they printed the results records (see Figure 3.2).

15. Plan República is a military deployment carried out by the Venezuelan Armed Forces in charge of safeguarding order in the electoral processes. Among other things, they are in charge of controlling the voting centers and safeguarding the electoral material.

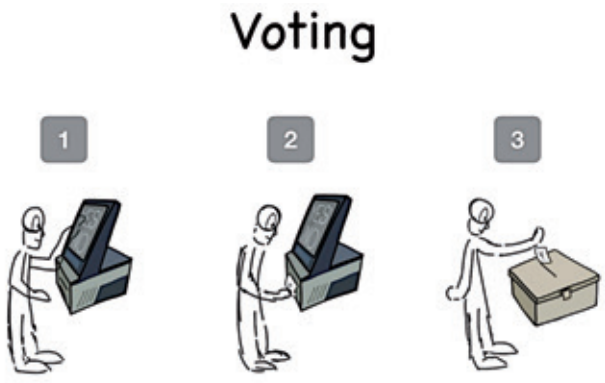


Figure 3.1. The voting process.

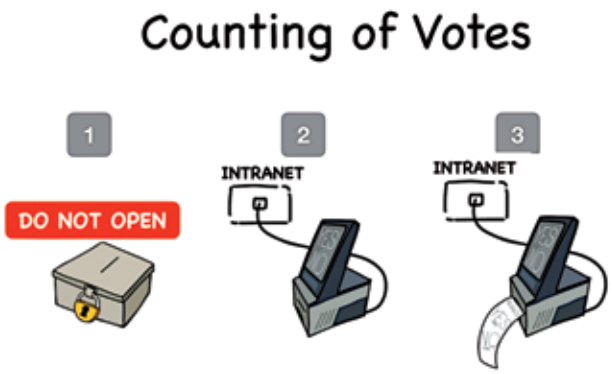


Figure 3.2. The process of scrutiny.

3.2. La auditoría que estaba prevista hacerle a los resultados de las máquinas de votación

The audit of the results as planned

In an attempt to build confidence in the results of the 19,664 machines that were installed for that referendum, an audit was planned. This was described in the Carter Center observation report:

> The audit regulation issued on August 12th stated that a random sample of 192 machines, 1 percent of the universe, should be audited immediately after the voting station closure. This audit consisted of the review and counting of the paper ballot of the sampled machines and comparing the results with the electronic count.

The audit of the results as performed

At the last minute, the planned audit of the results of the voting machines was curtailed due to an unforeseen situation. The Carter Center described this on their Report:

> Carter Center observers were able to witness six auditing processes. In only one of the six auditing sites observed by the Carter Center did the paper ballot receipt counting actually occur. In this place, the auditing was conducted by the mesa president, and the recount of the ballots produced exactly the same result as the acta printed by the voting machine. In the rest of the sites observed, the auditor appointed by the CNE did not allow the opening of the ballot box, explaining his/her instructions did not include the counting of the Yes and No ballots from multiple machines.

Where does this unforeseen situation come from?

Each computerized voting center consisted of one or more voting tables. At each voting table there were up to three voting machines and a single ballot box to deposit the ballots (see Figure 3.3). This caused the ballots from different machines to be mixed in a single ballot box, a fact that served as an excuse for the auditors appointed by the CNE to refuse to open the ballot boxes and count the ballots.

In this regard, Asdrúbal Aguiar[16], spokesman for the opposition, stated (see Ref. 22):

> (...) it was absolutely unjustifiable that the hot audit, which had been agreed in advance between the government and the opposition with the support of international organizations and which should have been performed the same night on the closing of the voting centers in Venezuela, had not been complied with.
> (...)
>
> A sudden decision had been taken not to use one ballot box for each voting machine as it was foreseen in the regulations, but instead three machines were used for one single ballot box, confusing the votes from one machine to another.

16. Asdrúbal Aguiar is a Member of the Real Academia Hispanoamericana de Ciencias, Artes y Letras of Spain, of the International Academy of Comparative Law of The Hague, of the National Academies of Moral and Political Sciences and of Law and Social Sciences of Buenos Aires and served as Judge of the Inter-American Court of Human Rights.

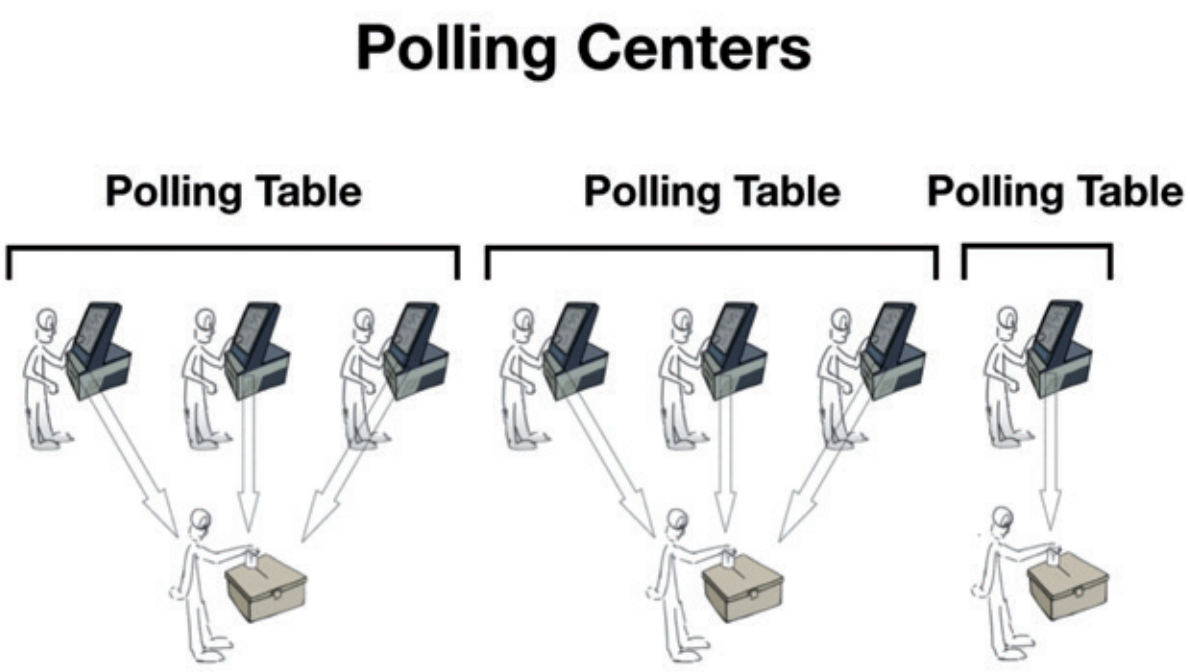


Figure 3.3. The arrangement of the voting centers.

The vice-president of the CNE, Ezequiel Zamora, left a record of what happened during this audit in his letter of resignation to this organization [Ref. 23]:

> ...the representatives and witnesses of the "YES" option did not receive in a timely manner the necessary credentials to participate in all the voting tables that were to be audited, being able to do it only in 27 voting tables out of the corresponding 199 (...) there were obstructions by Plan República to the access of witnesses and international observers to the planned audit.

To decipher how this electronic voting system works, it is essential to understand what happened with this audit.

3.3. On the effectiveness of the audit used to certify the results of the voting machines

After the planned audit of the results of the voting machines was curtail, the representatives of the opposition requested the CNE to conduct a second audit. They demanded guarantees to be offered about the randomness of the draw in which the machines whose results were to be audited would be selected and that the origin of the ballot boxes and ballot to be used in this second audit be certified. After arduous discussions, the opposition representatives considered that the audit protocol offered by the CNE did not guarantee either of these two points and therefore withdrew from the audit.

In his resignation letter, Dr. Ezequiel Zamora also stated what happened with this audit:

> Upon the request of one of the actors of the process to conduct a new audit, under conditions acceptable to all parties, the majority of the Board of Directors of the National Electoral Council (CNE) decided to conduct the audit only in the terms agreed by them with part of the international observation, denying the petitioner of the audit, as advised by electoral practices, the right to participate in the design of the sample and the methodology to conduct such audit, reason for which, the petitioner of the audit decided not to participate in it.

This audit was performed even though the opposition representatives were not present. On this second occasion, the auditors appointed by the CNE did not prevent the ballot boxes from being opened and the ballots from being counted[17], and the counting of the ballots corroborated the results that the voting machines had given. The Carter Center recorded this in its Report:

> The audit concluded the voting machines did accurately reflect the intent of the voters, as evidenced by a recount of the paper ballots in a sample of machines.

This audit had two major security gaps in its design, which made it totally ineffective.

1. The sample used in this audit was selected on a CNE computer, with a program made by the CNE and operated by CNE personnel; the same entity that was the subject of the audit was the one that selected the sample, so there were serious doubts about its random origin.

2. Despite the fact that there was a mechanism that allowed this to be done, the boxes with ballots that were used in this second audit to cross-check the results of the machines were not certified as to their origin. At the closing of the voting centers, when the ballot boxes were closed and sealed, the seals were signed by the table members and witnesses. Immediately thereafter they were placed under the custody of the Venezuelan Armed Forces. Neither the voting table members nor

17. For this second audit of the results, the CNE took the precaution of selecting electoral tables and not voting machines to compare the results. With this, because each electoral table had a ballot box, the problem that arose in the first audit was avoided; the confusion of voting ballots from different machines in the same ballot box.

the witnesses who had signed the seals were called to certify the authenticity of the boxes.

In this second audit, two other events occurred that caused particular suspicion:

1. The -electronic- draw in which the machines whose results would be compared were chosen, was broadcast live on the official television channel, but no information was given as to which machines were selected. In this way, the table members and witnesses who had signed the seals of the ballot boxes corresponding to the machines that would be audited, could not even see this transmission to know that the boxes whose seals they had supposedly signed would be opened during the audit. Normally, the idea of broadcasting a draw on television is to verify the transparency of the draw and to make the results known.
2. The draws for hot and cold auditing included sixteen common centers. These sixteen (16) centers were successfully cold audited, but none of them were allowed to be hot audited.

When the opposition questioned this audit, the Carter Center and the OAS, in order to defend its effectiveness, showed that the results of the sample used in this audit were representative of the official results of the universe of voting machines. This fact only allows us to conclude that the results of some boxes that the CNE prevented from having their origin certified, were representative of the results of the machines, which the CNE prevented from being cross-checked, but it does not indicate anything regarding to the validity of the results of the voting machines.

Everything that is narrated in this section coincides with what would be the realization of a fraud. But did it really exist?

SECTION 4

STATISTICAL MATHEMATICS AND ELECTORAL FRAUD DETECTION

4.1. Driven to statistical mathematics by a state of necessity

Many Venezuelans were dissatisfied with what had happened. The ideal way to know whether or not fraud had occurred would have been to allow all the ballot boxes to be opened and all ballots to be counted at the closing of the voting centers, but this was not allowed by the CNE. To make matters worse, none of the audits, nor the one that had been performed to the software and hardware of the voting machines, nor the one attempted to the results of the machines right after of the closing of the voting centers, nor the one performed three days after the voting, served to certify the veracity of the results of the machines.

This lack of transparency caused by the decisions of the CNE, together with the ethereal nature of the electronic vote, left Venezuelans in a state of defenselessness. Under these circumstances, how could they know if the results given by the voting machines were true or not? There was only one option left: the electoral body had published data related to this referendum (the number of votes, the list of signatories of the referendum petition, the registry of electors, etc.) that could be analyzed. Thus, Venezuelans were brought to a state of need and the only tool they had left to know if the results given by the machines were true or not was statistical mathematics. The Carter Center, for its part, created an *ad hoc* Panel of Specialists to evaluate the evidence of fraud that arose based on this branch of mathematics.

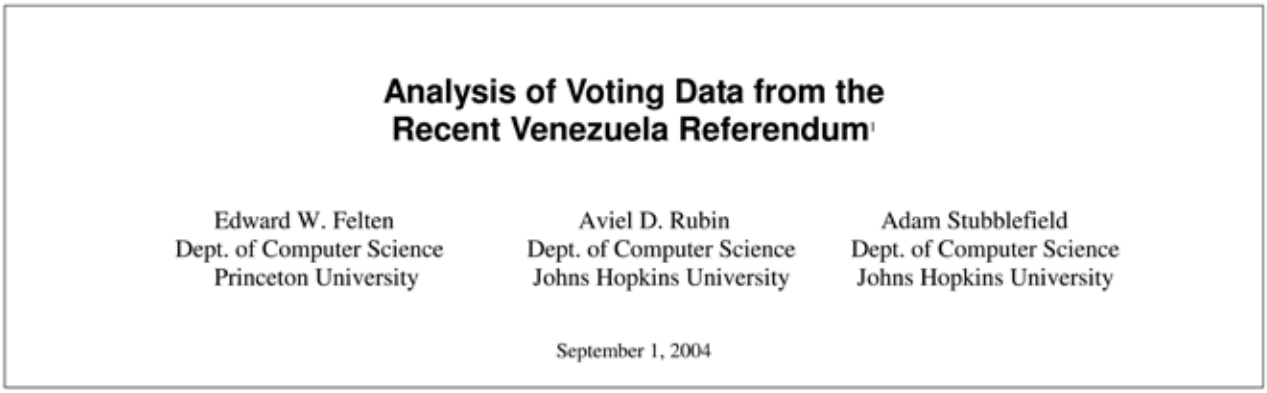
4.2. Allegations of electoral fraud based on statistical mathematics

Certain types of fraud -due to the mechanisms or algorithms they use- can introduce anomalous or unexpected behavior in the election results. These can be detected and become evidence of fraud. This is how statistical mathematics can provide unconventional evidence of fraud that sometimes lies in small details that are difficult to find and that are not always easy to understand, but which are not less convincing.

The first allegation of fraud against the veracity of the official results of the 2004 referendum in Venezuela became known as the "Theory of the Tops". In 190 voting centers two or more voting machines had given the same number of Yes votes, votes to revoke the mandate of the President. Some believed that this fact could have been caused by the existence of a "top" on the Yes votes that had been maliciously introduced to the voting machines, the same for all the machines in the same voting center; once the "top" was reached, all the votes that the machines received would be added to the No option.

This fact, which some considered evidence of fraud, was brought by the Venezuelan opposition to professors Edward W. Felten, Aviel D. Rubin and Adam Stubblefield for evaluation. They responded with the paper *Analysis of Voting Data from the Recent Venezuela Referendum* [Ref. 24] (see Figure 4.1) in which they concluded that this number of numerical repetitions of the Yes votes was within the expected range and therefore this fact could not be considered evidence of fraud.

The Carter Center, for its part, sent this alleged evidence of fraud to Jonathan Taylor, a young mathematician who, despite his young age, was already a professor at Stanford University. Taylor in his paper, *Too Many ties? An empirical analysis of the Venezuelan recall referendum counts* [Ref. 25], with a different mechanism than the one



Analysis of Voting Data from the Recent Venezuela Referendum[1]

Edward W. Felten
Dept. of Computer Science
Princeton University

Aviel D. Rubin
Dept. of Computer Science
Johns Hopkins University

Adam Stubblefield
Dept. of Computer Science
Johns Hopkins University

September 1, 2004

Figure 4.1. Heading of the paper by Felten, Rubin and Stubblefield.

used by Felten, Rubin and Stubblefield, reached the same conclusion: the number of repetitions was within the expected range.

That a fraud committed by imposing the same top on the number of Yes votes on all the voting machines in the same voting center would have been something extremely crude.

Felten, Rubin and Stubblefield in Section 4 of their paper, *Background on Statistical Analysis,* delve into this topic and explain step by step how a fraud allegation based on statistical mathematics should be structured. This section is divided into three parts that are summarized below.

In the first, *Hypothesis Testing,* remember that:

> Statistical analyzes can only determine whether the observed data are consistent or inconsistent with the hypothesis. If the data are inconsistent with the hypothesis, this is evidence against the truth of the hypothesis. But if the data are consistent with the hypothesis, this does not establish that the hypothesis is true.

The hypothesis that is subjected to this test, which is usually the generally accepted one, is called the null hypothesis (Ho). A different hypothesis is called the alternative hypothesis (Ha) (see Figure 4.2).

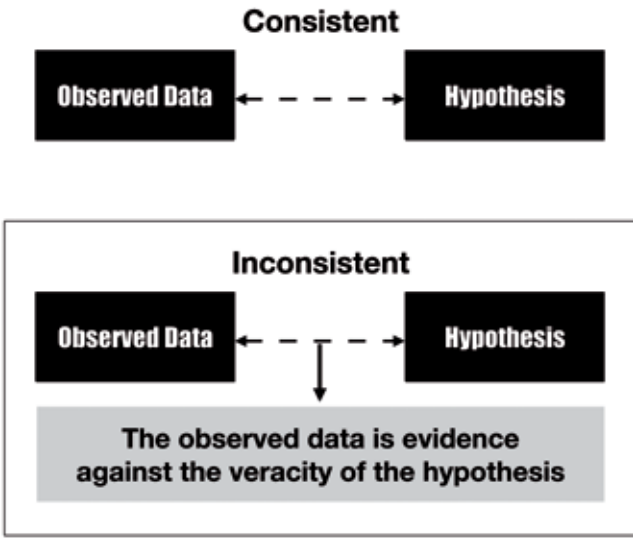


Figure 4.2. Diagram of the reasoning for rejecting or not a hypothesis.

In the second, *Random Variation*, they explains the difference between statistical fluctuations that are within the expected ranges -under the assumption that Ho is true- and those that are extremely unexpected because they are far outside these ranges. Behaviors with this latter type of fluctuations are considered anomalous. This is how the report by Felten, Rubin and Stubblefield explain it:

> For example, if we were to flip 1000 coins and count the total number of times heads came up, we know that on average we would see 500 heads.
> (...)
>
> For example, in our coin-flip experiment, the result will be outside the range 484-516 about 34% of the time, and outside the range 468-532 about 5% of the time. If we widen the interval further, the chance that the result is outside our widened interval get ever closer to zero.
> (...)
>
> Suppose someone told us that they had flipped 1000 coins and got 644 heads... A result of this many standard deviations away from the mean would happen only 0.00000000000000002% of the time by chance. We could safely conclude that this person was lying.

The Figure 4.3 shows, through graphs, how the expected results are usually grouped around a certain value, 500 in this case.

And in the third part, *Avoiding the Lottery Fallacy,* they refer to the need to relate the anomalous behaviors observed to some probable mechanism of fraud:

> To avoid the lottery fallacy, we need to argue either that we chose in advance to look for that pattern as evidence of fraud, or that there is some reason to believe that that particular pattern would be caused by some likely mechanism of fraud.

That the results of the voting machines had been adulterated using a specific and probable mathematical model of fraud would be the alternative hypothesis (Ha).

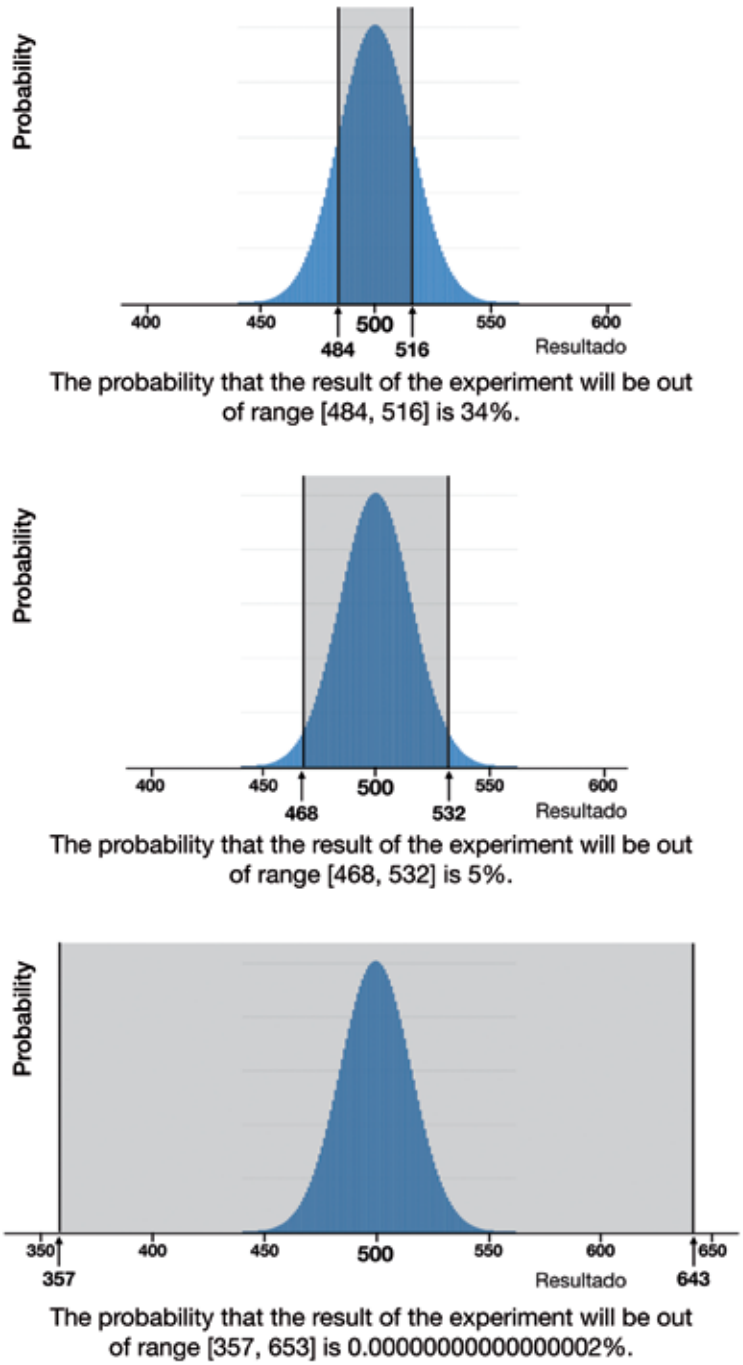


Figure 4.3. When tossing a coin 1,000 times, each possible outcome - the number of times it lands heads - has a specific probability of occurring. For example, the probability of obtaining a result of 1,000 is very different (much lower) than that of obtaining 522. Each of the possible results - from 0 to 1,000 - has a certain probability of occurring. The three upper graphs show in blue how in this case these probabilities are distributed as a function of the possible results. Note how the most probable results are grouped around 500 and how as they move away from this value, the probability of their occurrence decreases very sharply. This makes results distant from 500, such as 644, very rare and unexpected. The upper graph highlights the range of results that go between 484 and 516, in the middle one the one that goes between 468 and 532 and in the bottom one the one that goes from 357 to 643. It is indicated, for each of these ranges, what is the probability of obtaining a result outside of them. Note that due to the way these probabilities are distributed, it is extremely unlikely to obtain a result that could be outside the range [357, 643].

In summary, according to what was stated by Felten, Rubin and Stubblefield, to substantiate an allegation of electoral fraud, it is necessary to:

1. Assume that the results given by the voting machines were the true ones. This would be Ho.
2. To obtain an anomalous behavior incompatible with this hypothesis -which, being far from the "expected value" under this assumption, that Ho is true, would have been extremely unlikely to occur-, and
3. Demonstrate that there is some specific and probable fraud mechanism or mathematical model that, if used to adulterate the results of the machines, would have produced the same anomaly as the one observed. That this specific and probable mechanism of fraud would have been used would be Ha.

Next, we will see how all this relates to the numbers of No votes reported by the voting machines.

SECTION 5

COUNTING THE SECOND DIGITS

5.1. Benford's Law and fraud detections

If we look at the set of numbers shown in Figure 5.1, we will immediately notice that many of them -8 out of 16- have 9 as their second significant digit -the second from left to right-. At seeing it we will think that there are too many numbers with second digit 9 so that they have come from a random process. We could even associate them with the price lists of department stores, where for commercial reasons, they often forced it to have this behavior.

In 1995 *Statistical Science* published the article *A Statistical Derivation of the Significant-Digit Law* by T.P. Hill [Ref. 26]. In it, theoretical support is given to what until then was a kind of mathematical curiosity or empirical law, which, despite the fact that it had been discovered by Simon Newcomb in 1881 and rediscovered by Frank Benford in 1938, was practically unknown. In it, its author comments that among the possible applications that this law could have it was the detection of accounting fraud.

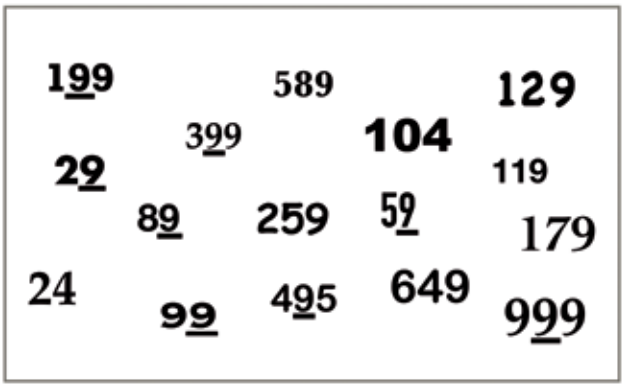


Figure 5.1.

In March 2001, *Fortune* published the article *Is Enron Overpriced?* [Ref. 27]. In it, its author Bethany McLean remarked that some irregularities in the financial documents of this company indicated that the high price of its shares was not justified. This article triggered a series of investigations that exposed a massive accounting fraud. In 2005, Mark Nigrini published the article *An Assessment of the Change in the Incidence of Earnings Management around the Enron - Andersen Episode* [Ref. 28], which shows that if the second digits of the balance sheets of Enron had been observed, this fraud could have been detected. In them there were too many numbers with second digits 0; it was as if they had been enlarged and rounded to make them more striking (see Figure 5.2).

In 2007, the *European Journal of Physics* published *How the numbers begin? (The First Digits Law)* [Ref. 29], in it its authors, J. Torres, S. Fernández, A. Gamero and A. Sola showed the Benford's Law, a law that was beginning to become known, to the readers of this popular science journal. When referring to the applications of this law, they highlighted its ability to detect fraud. In addition to mentioning Nigrini and the issue of accounting fraud, they stated:

> Nowadays, the Law of Benford can also be useful for reporting electoral fraud, or at least to detect voting anomalies, as has been shown in recent papers. Some studies based on the Law of Benford have shown some anomalies in the voting results of the controversial presidential election in the USA, concretely in the Florida state, or in the presidential referendum in Venezuela in 2004.

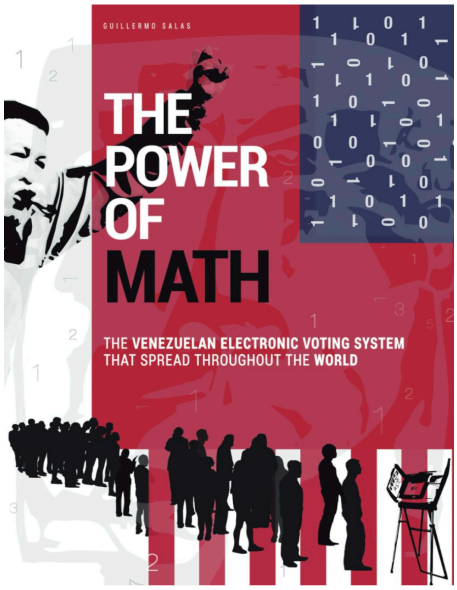
Thank you very much for reading this first part of The Power of Mathematics.

If you've read this far, you now have the information needed to infer:

1- Whether or not the origins of this electronic voting system are what one would expect from a fraudulent system (Section 2), and

2- Whether or not the irregularities observed and documented in the electoral processes organized and controlled by Chavismo allow an electronic voting system designed to commit fraud to massively tamper with the results (Section 3).

The following sections of this book present the information that will allow you to figure out how this so-called electronic voting system works (how it rigs the vote).



Available on Amazon